NOVEMBER 1956

THE WELDING JOURNAL

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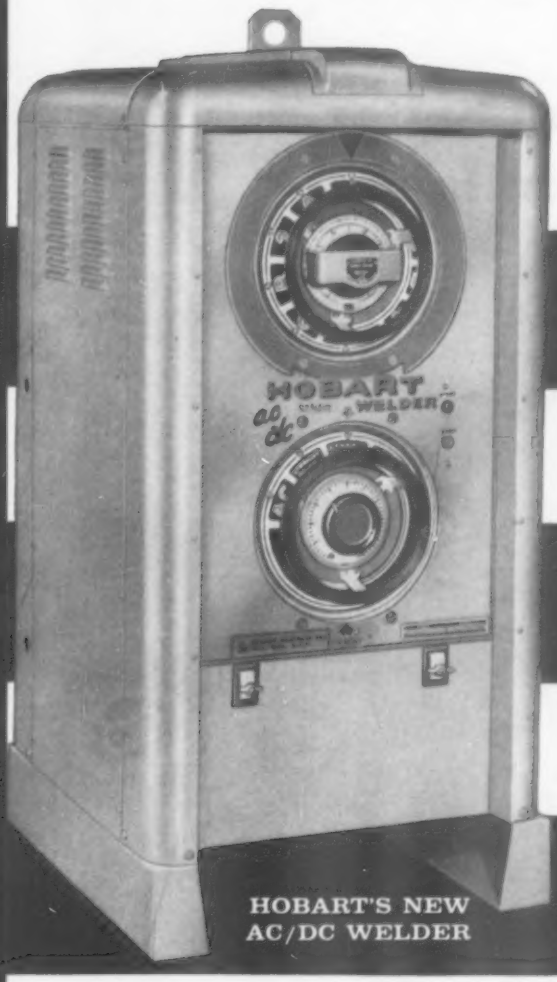

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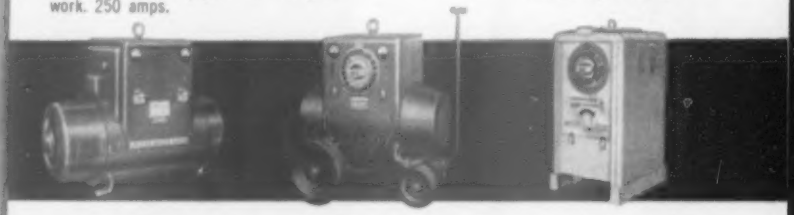

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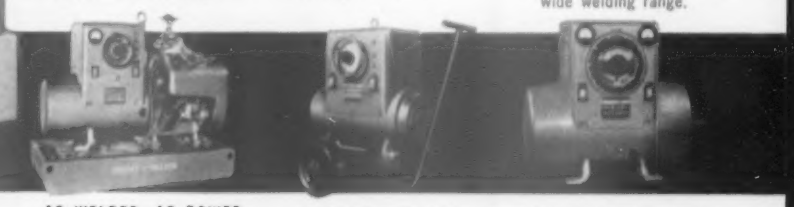

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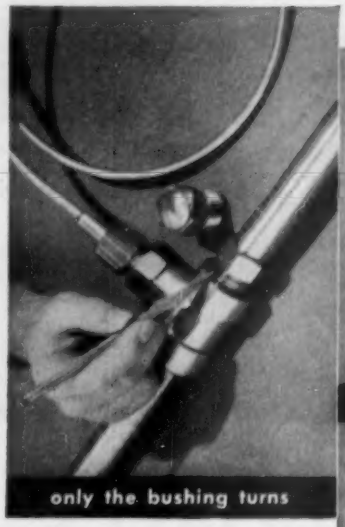

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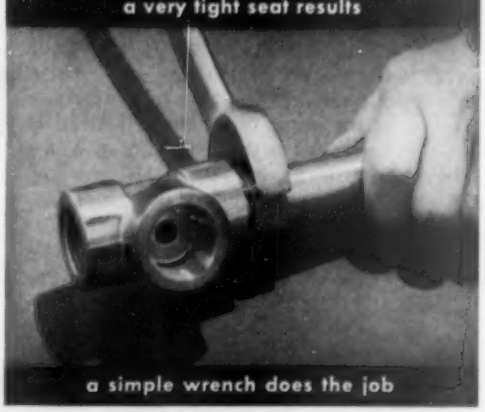

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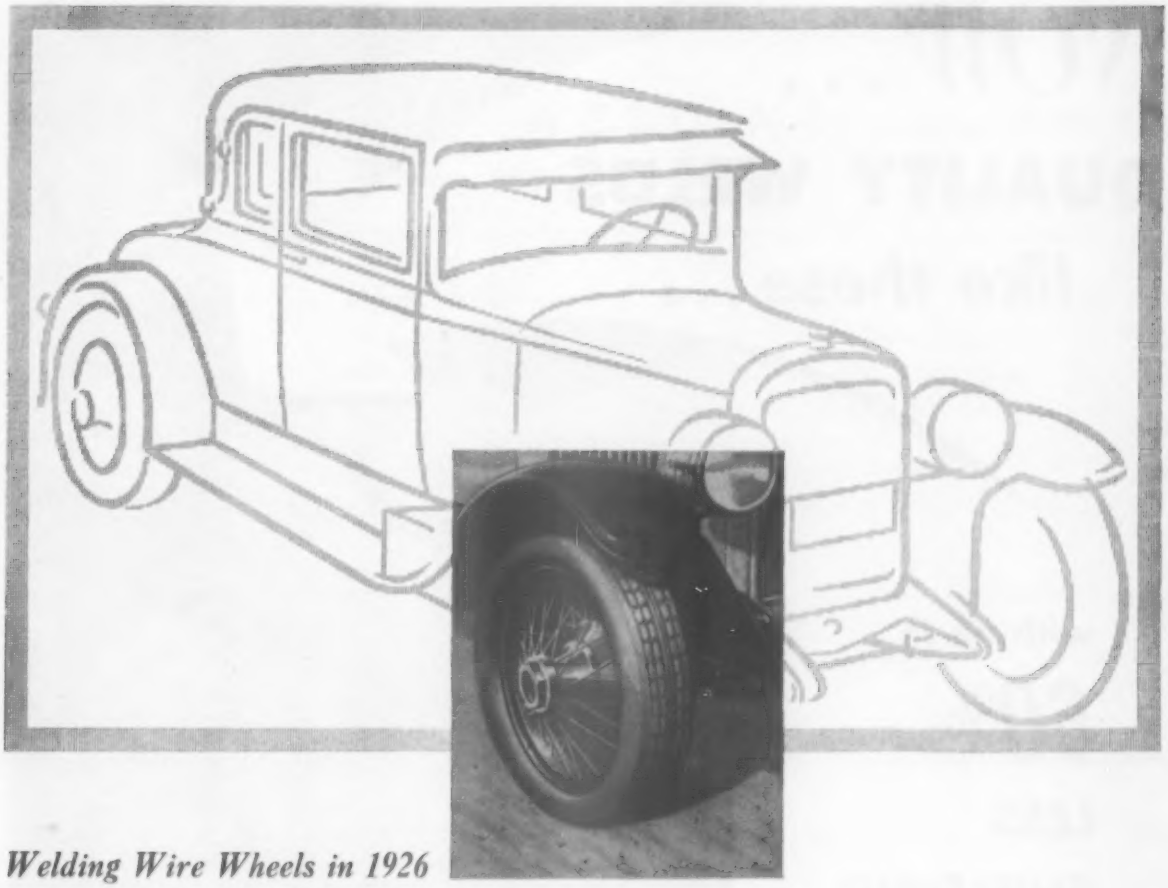

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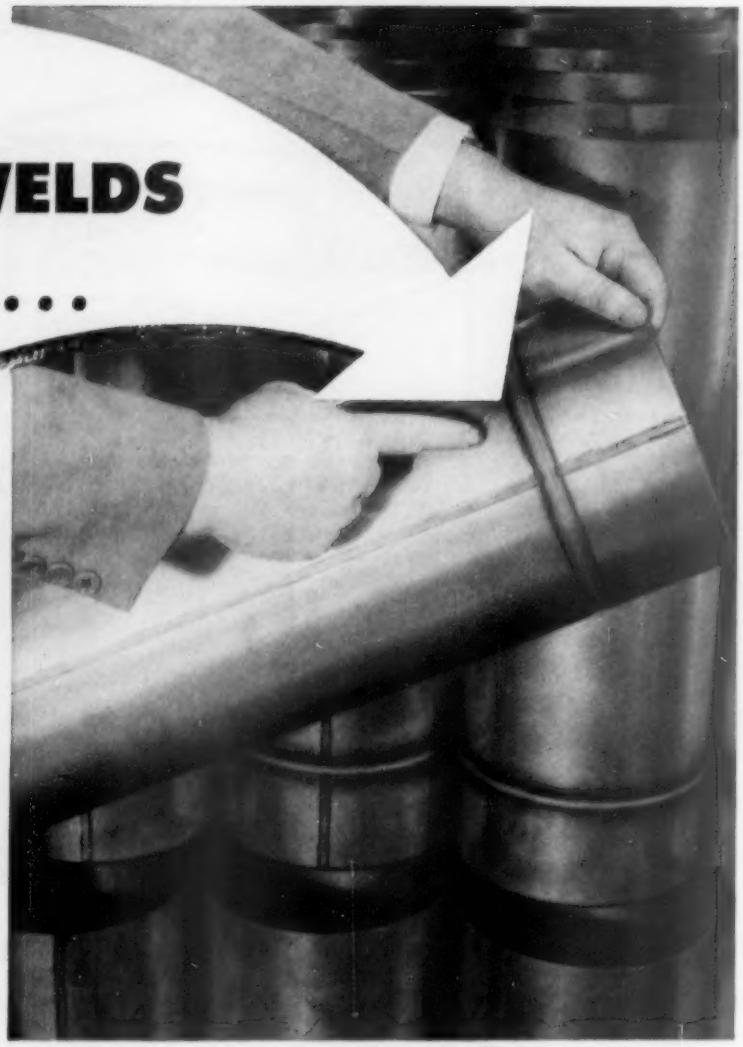

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THE WELDING JOURNAL

VOLUME 35 • NUMBER 11 • NOVEMBER 1956

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EDITORIAL

A letter to William H. Eisenman, Secretary, American Society for Metals

DEAR MR. EISENMAN:

It is a distinct pleasure for me, in behalf of our SOCIETY, its membership and its officers, at this termination of a period of many, many years of enjoyable and profitable collaboration and cooperation between the American Society for Metals and the AMERICAN WELDING SOCIETY through the medium of the National Metal Exposition, to express our sincere appreciation to the American Society for Metals, its membership and its officers for the grand association and the amicable conductance during more than a quarter of a century which have attended our joint endeavor.

We wish it to be known that the AMERICAN WELDING SOCIETY has measurably and perceptably gained from this association, one which we sincerely hope has been beneficial likewise to the American Society for Metals. It was inevitable that, in gaining therefrom, we would increase our SOCIETY's stature and eventually grow in size and importance requiring that we seek a path of specialized activity and exposition which would further serve an ever-growing welding industry and profession. Our All-Welding Show, a modest adventure in the spring of 1953, has now proved itself to be the vehicle for accomplishing that end. We must enter into the records that the experience our SOCIETY gained during its years of beneficial association with the National Metal Exposition enabled AWS to establish a pattern of comparably high standards and formulate a program for welding exposition which has been beneficial to our welding industry and profession. For that, and many other things of value, we are most appreciative to the National Metal Exposition and its sponsor, the American Society for Metals.

Accordingly, we hereby register the close of, for our part, a fruitful and pleasant participation in the National Metal Congress and National Metal Exposition, with mixed feelings; regret that scale of activity has dictated that our paths diverge, and sincere appreciation to your Society for the honor you bestowed upon us these past many years through allowing us the privilege of joint sponsorship in your notable activities. Our SOCIETY has none other than the kindest feelings toward your esteemed organization and its very best wishes for the continued and increasing success of your valued endeavors.

We respectfully suggest that our feelings and appreciation, as herein expressed, be made known to the officers and trustees of the American Society for Metals.

J. G. Magrath
NATIONAL SECRETARY
AMERICAN WELDING SOCIETY

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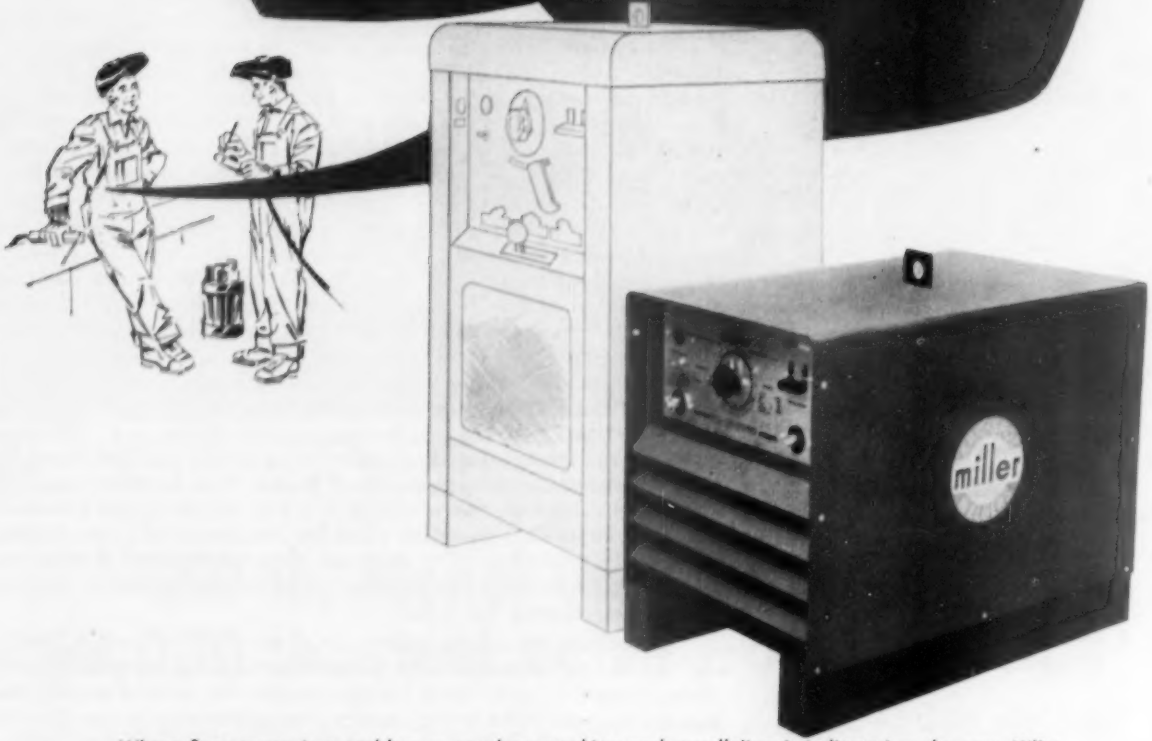

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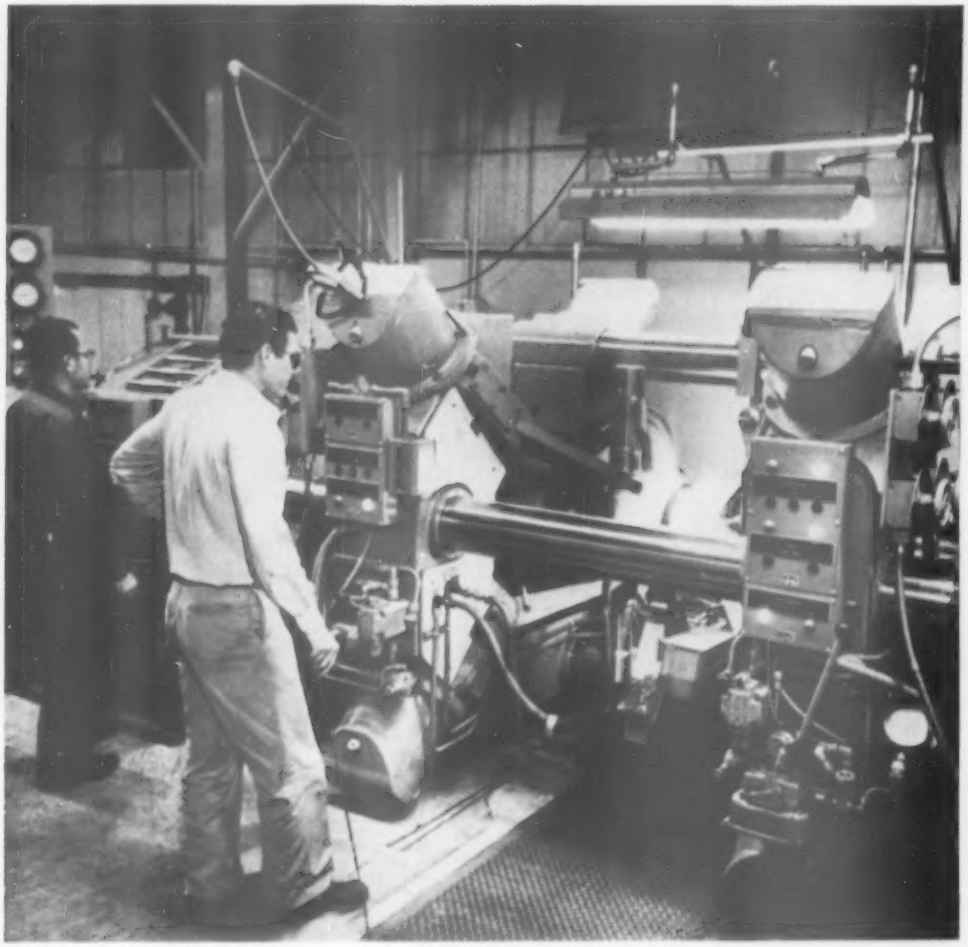


Fig. 1 20-in. pressure-welding machine in operation

APPLICATION OF PRESSURE WELDING TO THE AIRCRAFT INDUSTRY

Pressure welding is described as being a most desirable means of joining alloy steel for aircraft use at any reasonable heat-treat level

BY ARNOLD P. LAGE

Arnold P. Lage is Welding Group Leader, Menasco Manufacturing Co., Burbank, Calif.

Presented at the 1956 AWS National Spring Meeting in Buffalo, N. Y., May 7–11.

Introduction

Pressure welding, as a means of joining ferrous and nonferrous metals, has been used extensively in the railroad and oil industries for many years.

Early in the 1940's, Menasco engineers became interested in the possibility of using pressure welding as a process for fabricating aircraft landing gear components of alloy steel such as 4130, 4140 and 4340. After an extensive development program, the first assembly using the pressure welding process was completed in 1943 (Fig. 2). Since that date, many design applications have been found for pressure welding. It is interesting to note that as many as 20,000 pressure welds have been used in gear assemblies in one year.

The process produces a forged butt weld by upsetting

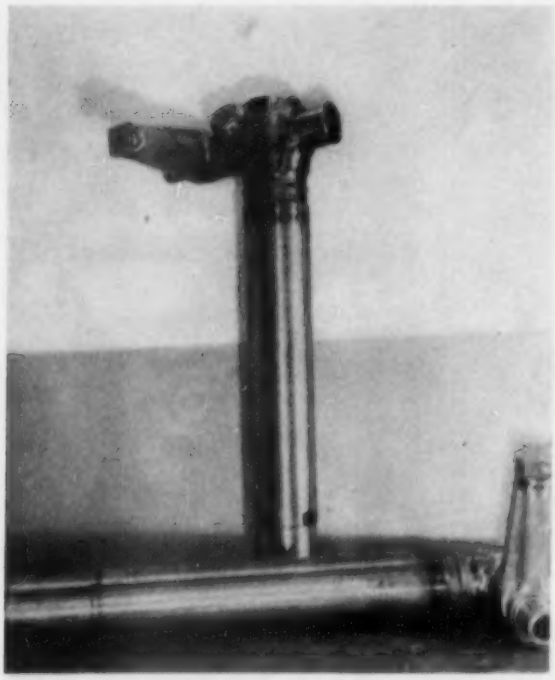


Fig. 2 First assembly built by using pressure welding as a means of joining an alloy steel forging to a tubular section

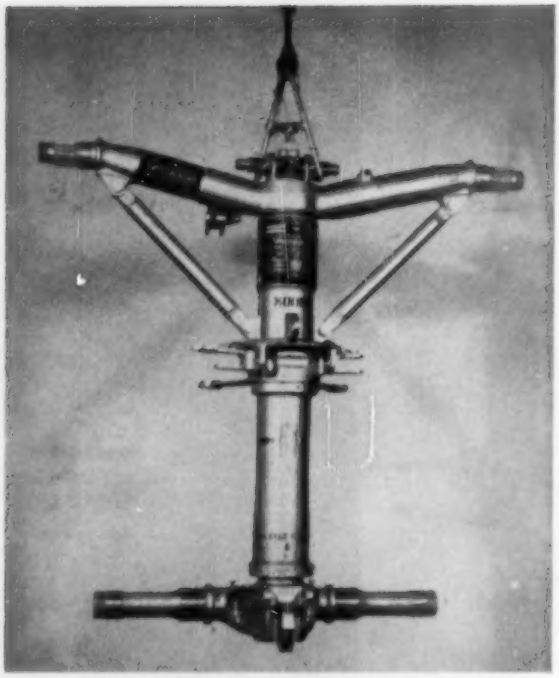


Fig. 4 Shock strut assembly with two pressure welds in cylinder, and one pressure weld in piston. (HT 260,000–280,000 UTS)

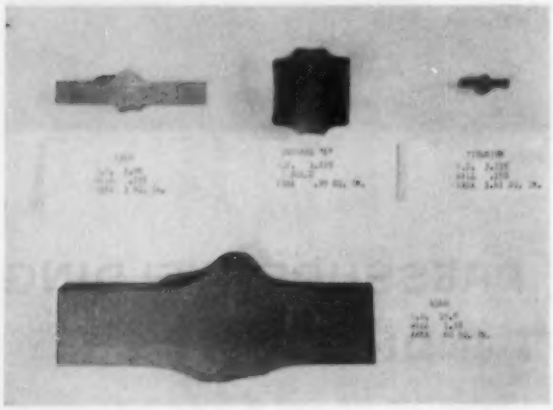


Fig. 3 Cross sections of two pressure welds in alloy steel and a small titanium weld (tubular) and a solid bar of Inconel "X"

Table 1—High-Strength Welds

Weld size, in.	*Area sq in.*	*Alloy*	*Heat treat, psi*
4.125 x 0.346	4.08	4340	260,000–280,000
5.090 x 0.480	6.69	4340	260,000–280,000
5.188 x 0.344	5.23	4340	260,000–280,000
5.250 x 0.485	7.26	4330 mod.	220,000–240,000
6.250 x 0.460	8.38	4340	260,000–280,000
6.250 x 0.525	9.44	4340	260,000–280,000
6.750 x 0.525	10.27	4340	260,000–280,000
7.250 x 0.672	14.6	4340	260,000–280,000
8.225 x 0.612	14.65	4340	260,000–280,000
9.550 x 0.420	12.04	4340	260,000–280,000

the faying surfaces under heat and pressure. The heating system consists of a multi-orifice circular heating head with suitable pressure regulators and flowmeters to control the gas mixture (oxygen and acetylene) to produce the required heat at the faying surfaces. The welding pressure is supplied by a hydraulic system of adequate size to produce forging pressures that may vary from 3000 to 15,000 pounds per square inch of weld area.

A typical welding cycle is as follows: the specimens to be welded are aligned in the machine, predetermined welding force is applied, the heating head is fired, after the faying surfaces have had sufficient heating time for the material to reach the forging temperature and the applied pressure has caused the material to upset to the predetermined required amount, a series of microswitches are automatically activated to end the weld cycle by shutting off the gas flow to the heating head and dumping the hydraulic welding force.

Pressure welding lends itself to the welding of steel in many shapes—those most commonly welded are: solid bar, flat stock, rectangular, I and T shapes, as well as tubular sections. We are primarily interested in tubular sections, using alloy steel in the heat treated condition. Actual weld sizes range from $1^1/_4$-in. OD x $^1/_8$-in. wall to $15^1/_2$-in. OD x $1^3/_8$-in. wall, having weld areas from $^1/_2$ to 60 sq in. and have been used in heat-treated strength levels from 150,000 to 280,000 psi ultimate tensile strength (see Fig. 3). Table 1 shows typical weld sizes and material used in production of high-strength assemblies consisting of major com-

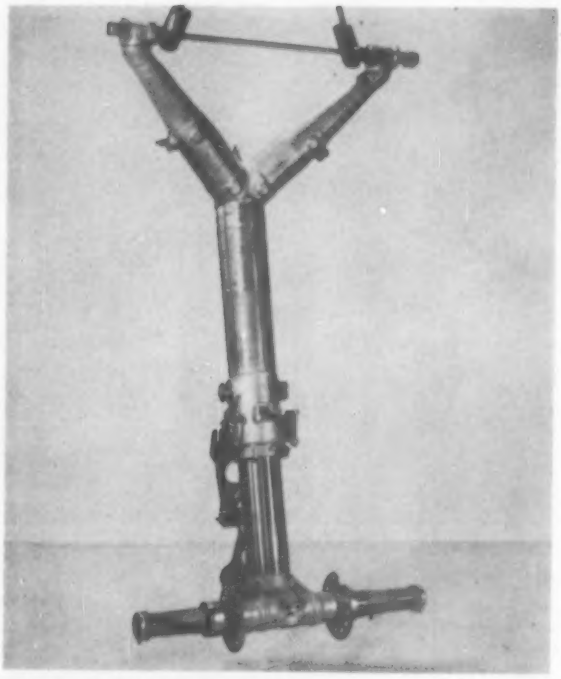


Fig. 5 Piston axle assembly using three pressure welds (2 axle welds and 1 piston weld)

ponents such as shock strut outer cylinders, pistons and axle assemblies.

The assembly in Fig. 4 has two welds in the outer cylinder and one weld in the piston (260,000–280,000 ultimate tensile strength).

Pressure welds are used in the normal heat treat ranges from 160,000 to 220,000 psi ultimate tensile strength for shock strut outer cylinders, piston-axle assemblies (see Fig. 5), actuator cylinders, compression and tension members and pressure vessels (see Fig. 6). Figure 7 is a typical shock strut assembly showing how forgings and tubes are joined together by using pressure welds.

To maintain the high quality of pressure welds, rigid manufacturing control and inspection procedures are followed. Before any production parts can be welded, the size must be qualified in accordance with pressure welding specification. A qualification consists of welding one or more metallurgical specimens and a minimum of six physical test specimens. Each metallurgical specimen is sectioned and examined to determine if the weld has the desired qualities to be used for production, as compared to the established weld quality standards.

When an acceptable metallurgical specimen has been welded, six more specimens are welded for physical testing. Weld data are recorded for each weld to be tested as a guide for production welding.

The physical test specimens are prepared by machining the OD upset flush with the test specimen diameter, removing the ID upset and the "chip"* to

* The chip is taken from the complete periphery of the ID upset and is used to examine and compare the weld quality of this part to known standards.

Fig. 6 Tank assembly 12 in. in diameter 18 in. long using two welds in the tubular section

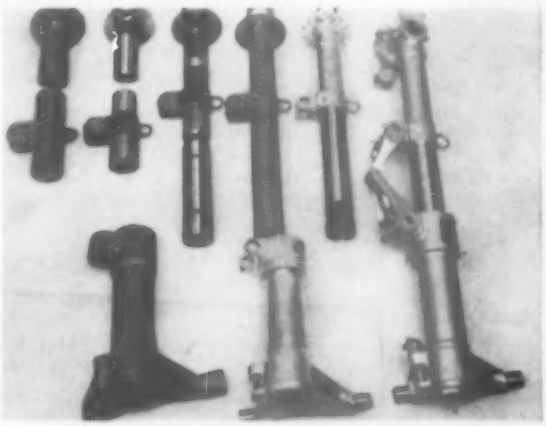


Fig. 7 Typical assembly showing how forgings are machined and welded; also, final assembly

within 0.005 to 0.015 in. of the ID wall, and then heat treating to the required range. Large welds to be tested in tension are cut into strip coupons before heat treating.

Bend Testing

Welds tested in bending must have a bending test

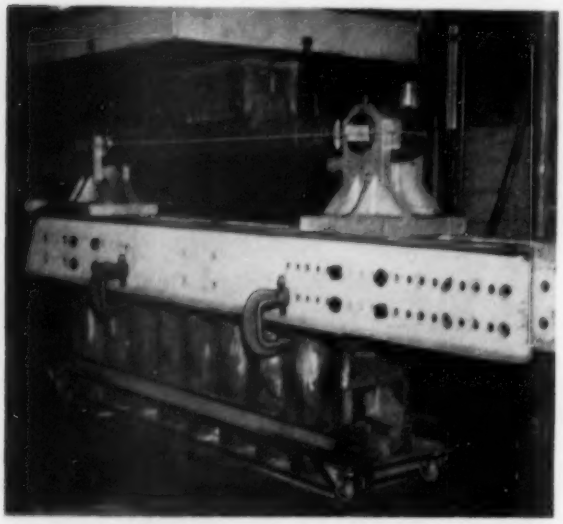


Fig. 8 A typical bend test setup. The weld is equally distant from either end of the test fixture

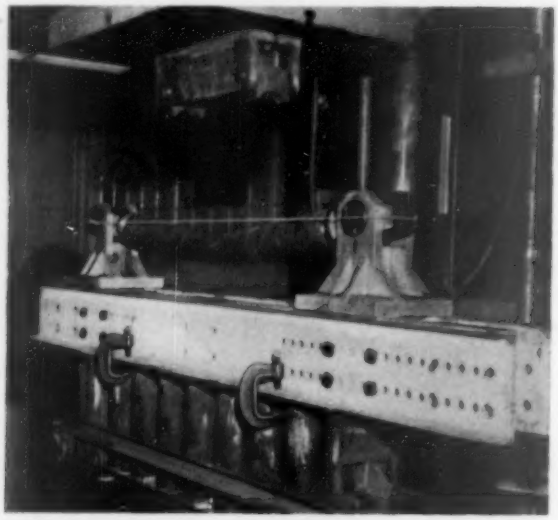


Fig. 9 Bend test specimen after failure. Note the amount of deformation

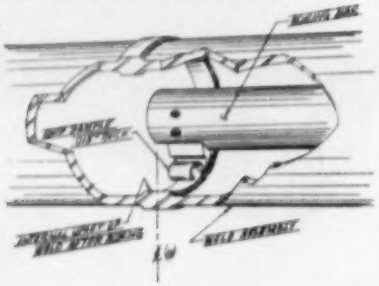


Fig. 10 Sketch of pressure-welded assembly in cross section, showing manner of removing "chip sample"

modulus equal to the bending modulus of alloy steel tubing of equal heat treat (see Figs. 8 and 9).

Tension

Weld strength in tension must be equivalent to the base metal strength with the lowest acceptable weld failures being 95% of the average base metal strength.

Chip inspection is an inspection control procedure developed to determine the metallurgical quality of each production weld. The chip consists of a tightly curled layer of metal representing the entire 360-deg circum-

Table 2—Inconel "X"

Tensile data (8T 0.505-in. diam tensile bars).

Material	*Condition*	*Test temperature, ° F*	*Ultimate tensile strength, psi*	*Yield, psi*	*Elongation, %*	*Reduction in area, %*
Weld	Annealed*	Room	144,700	...	24	33.7
Weld	Age hardened	Room	178,400	...	...	24.5
Weld	Age hardened	Room	179,000	126,000	15	25.4
Weld	Age hardened	Room	180,000	129,000	15	23.0
Weld	Age hardened	Room	182,800	135,500	14.5	23.7
Weld	Age hardened	Room	180,600	136,500	12.0	17.9
Weld	Age hardened	1000	159,900	120,200	16.0	33.9
Weld	Age hardened	1000	155,400	124,400	9.2	17.9
Weld	Age hardened	1350	115,000	105,800	2.0	5.2
Weld	Age hardened	1350	121,800	106,700	5.0	13.9
Base metal†	Age hardened	Room	184,000	132,000	24.0	37.0
Base metal†	Age hardened	1000	158,000	112,000	21.0	32.0
Base metal†	Age hardened	1200	142,000	100,000	12.0	17.0
Base metal†	Age hardened	1350	93,000	77,000	6.0	12.0

Fatigue data

Material	*Condition*	*Test temperature, ° F*	*Applied stress, psi*	*Test cycles*	*Type failure*
Weld	Age hardened	Room	55,000	10,000,000	No failure
Weld	Age hardened	Room	70,000	1,360,000	Weld
Base metal†	Age hardened	Room	47,500	10,000,000	Failed

* "Annealed"—1650° F for 3 hr followed by water quench. "Age hardened"—1650° F for 24 hr furnace cool to 1300° F held 20 hr then air cooled.

† Base metal data from International Nickel Co.: "Inconel 'X' data and information." Elevated temperature test and fatigue test preformed by Airesearch Mfg Co. Limited number of tests performed.

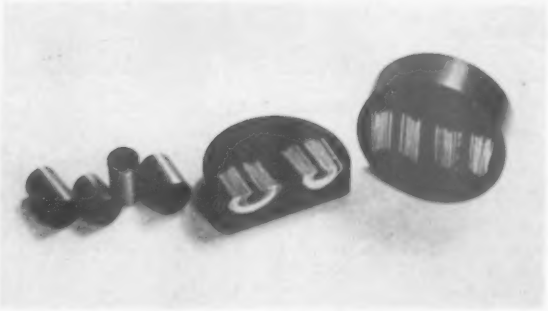


Fig. 11 Chips: Each weld is serialized and each chip bears the same serial number. Each of the exposed leaves contains a cross section of the weld

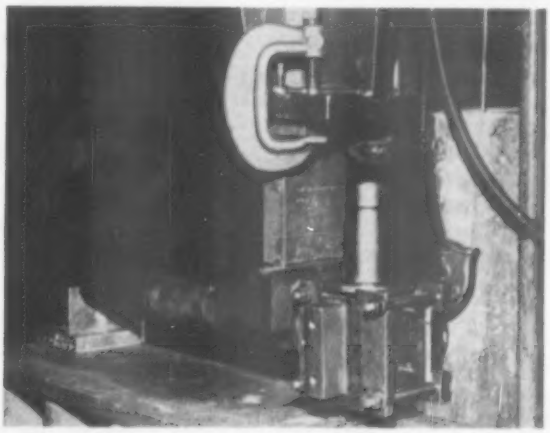


Fig. 12 Typical proofload

ference of the inside diameter of the weld, approximately 0.015 thick removed within 0.005 to 0.015 of the finished wall (Fig. 10). These chips are mounted in bakelite and ground approximately in half, exposing the coiled turns of the chip. Each leaf contains a portion of the weld (Fig. 11).

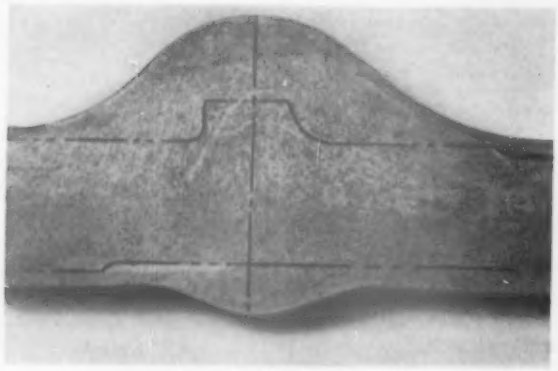
After polishing and etching, in alkaline chromate† solution, they are examined metallurgically and compared to established standards for weld quality and acceptability. All welded assemblies must be magnetically inspected after heat treat and all welds are subjected to a proofload test of 76% of the design load or as required by the blueprint.

Proofloads in bending are applied at four positions 90 deg apart through a loading saddle that conforms to the OD of the specimen and has 180 deg contact area. Figure 12 is a typical proofload setup.

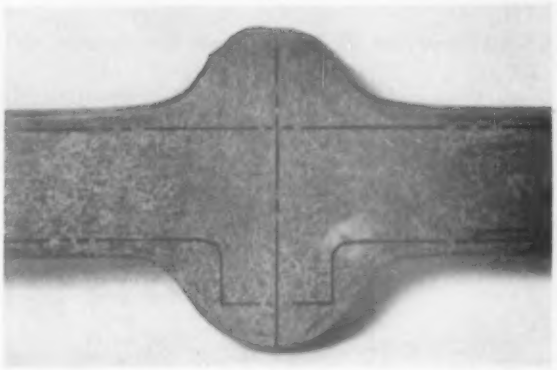
Upsetting

The pressure-weld process has another interesting application, that is, "upsetting." During the fabrication of cylindrical sections, inside or outside shoulders are often required. Normally, when additional material is required for shoulders, we must start with

† Alkaline chromate is a special etchant developed to reveal oxygen concentration on the weld plane.



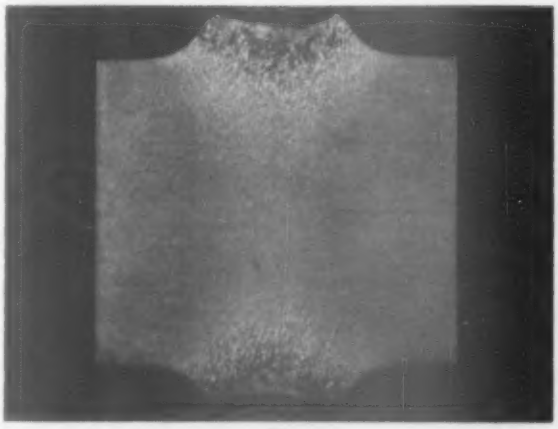
(A)



(B)

Fig. 13 Material upset to the OD (A) and material upset to ID (B). (12.500 OD x 1.125 wall)

(A)



(B)

Fig. 14 Pressure weld in Inconel "X" 1.187 OD solid bar. Cross section shows the resultant heat-affected zone

Table 3—Titanium Test Data

Alloy	Weld size, in. OD	Wall	Condition	Specimens	Ultimate tensile strength, psi	Yield, psi	Elongation, % in 4D	Reduction in area, %
3% Al, 5% Cr, low carbon	3.000 x	0.375	As-welded	Weld No. 1, 9 tensile bars	166,400	160,450	12.9	34.4
				Weld No. 2, 9 tensile bars	168,920	159,010	13.4	35.9
				Base metal, 3 tensile bars	159,030	146,970	16.3	40.5
3% Mn complex	3.000 x	0.500	Heat treated	Weld No. 1, tensile bars	167,800	142,000	9.0	19.5
				Weld No. 2, tensile bars	168,500	142,700	6.5	9.1
				Base metal, tensile bars	171,700	148,200	8.5	12.1
NOTE: Heat treat 1400° F, 1 hr; water quench, age at 900° F 8 hr, air cool.								
6% Al, 4% V	3.000 x	0.500	Heat treated	Weld No. 1, tensile bars	165,300	145,200	8.0	32.3
				Weld No. 2, tensile bars	167,000	147,000	8.0	34.0
				Base metal, tensile bars	173,300	158,200	10.0	29.3
				Base metal, tensile bars	171,300	154,000	9.0	25.5
NOTE: Heat treat 1775° F, 1 hr; water quench, age at 900° F, 8 hr, air cool.								
6% Al, 4% V	3.130 x	0.150	Heat treated above 170,000 psi,	6 welds All tests full size	174,800 Avg of 6	5 base metal failures 1 weld zone		

NOTE: Heat treat 1750–1775° F, ½ hr; water quench age at 900° F 8 hr, air cool. High-temperature furance was purged with argon 40 cfh for 2 min, then 20 cfh.

Charpy impact data

Alloy	Specimen	Room temperature	− 65° F	−320° F
6% Al, 4% V	Weld	12.5 ft-lb	10.5 ft-lb	9.0 ft-lb
	Weld	12.5	11.0	10.0
	Base metal	12.0	12.5	11.5
	Base metal	16.5	12.5	11.0
	Base metal	13.0	12.0	11.0

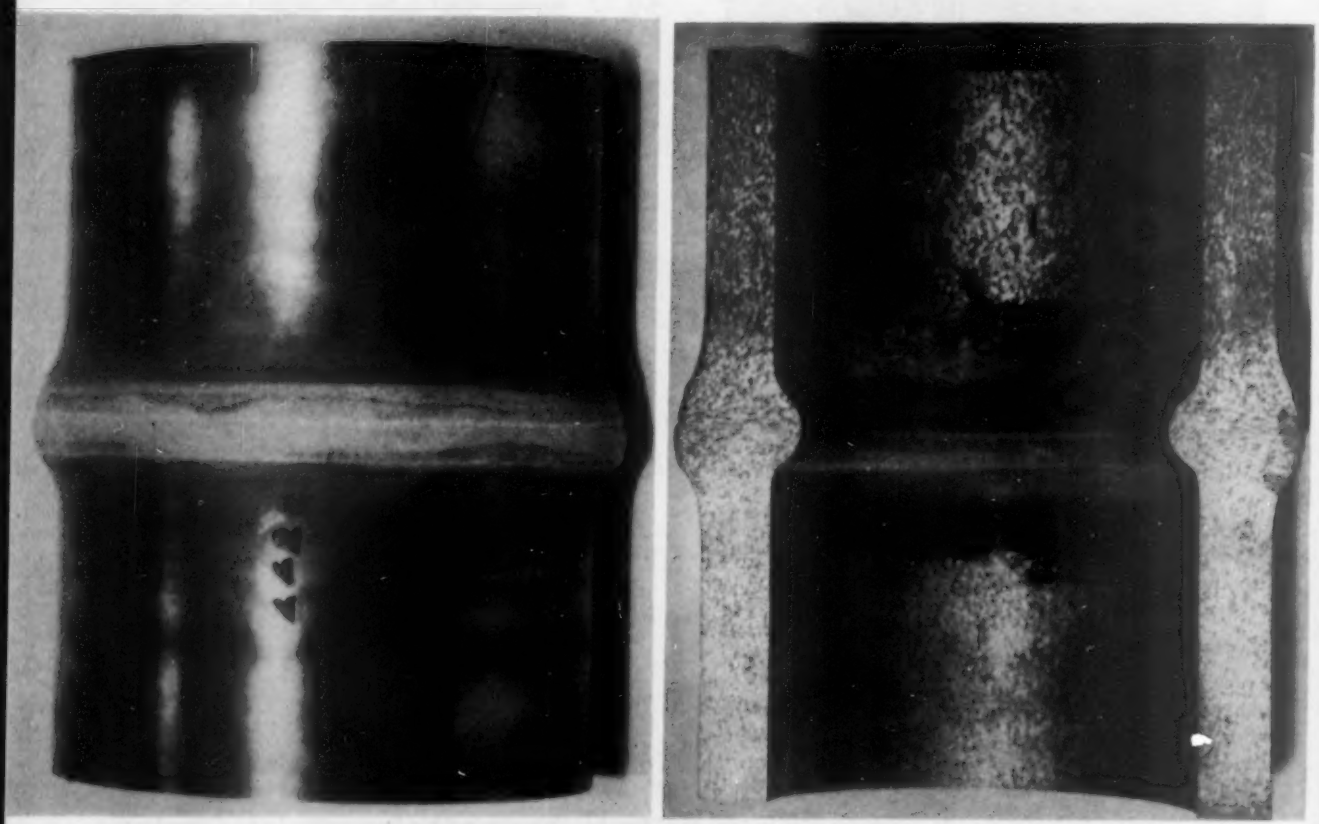


Fig. 15 Titanium pressure weld 3% Al–5% Cr. (3.000 OD x 0.375 wall)

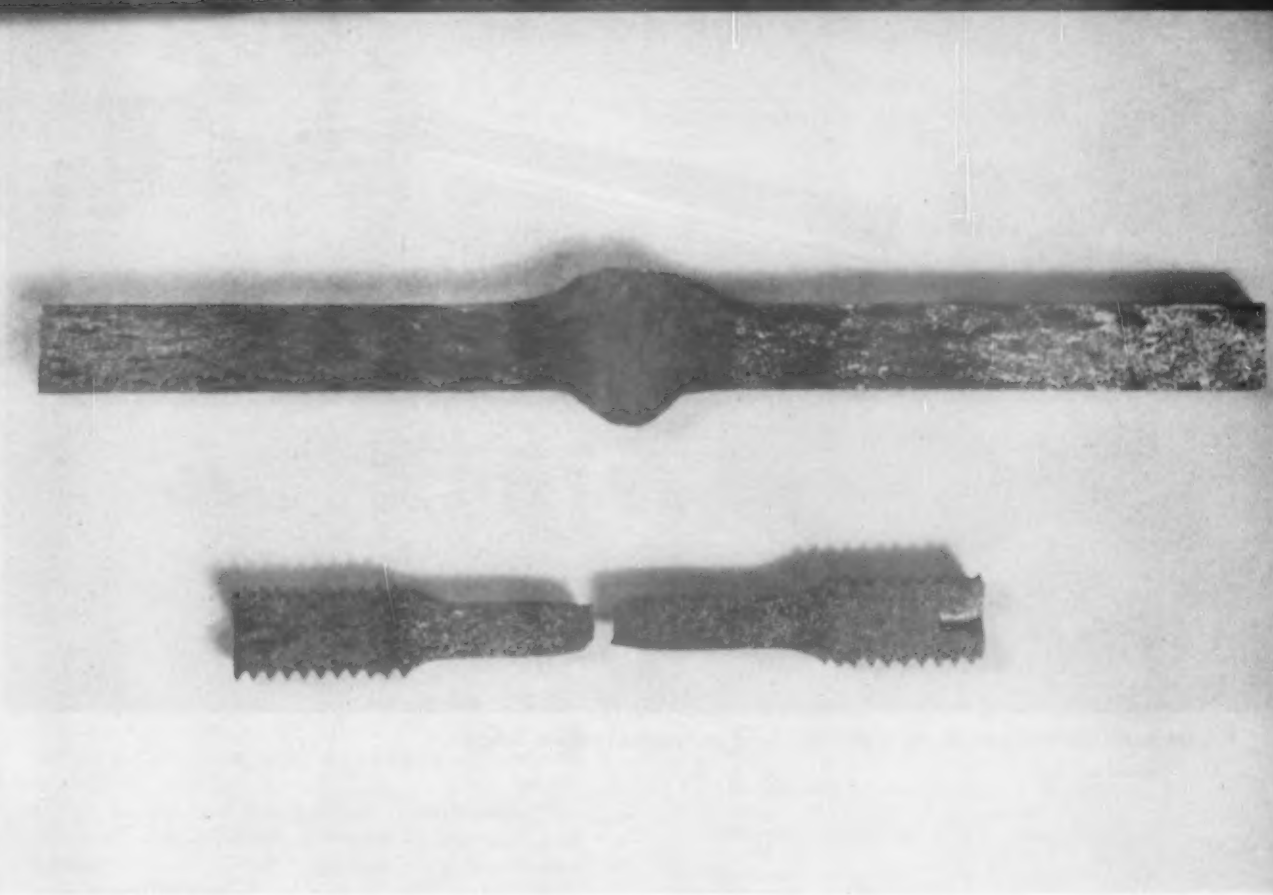


Fig. 16 Titanium pressure weld. Note that the fracture of the tensile bar shows elongation across the weld

stock or forgings of sufficient size so that these shoulders can be machined. By using the upsetting method, the wall thickness can be increased at the desired location either for the external or the internal shoulder (see Fig. 13).

The advantage of this process is that there is less rough machining or stock removal to make the final part.

Inconel "X"

Inconel "X," a high-strength, high-temperature alloy has been pressure welded. Welds made and tested using a 1.125-in. diam solid bar show that pressure welding is a satisfactory means of joining Inconel "X" (Fig. 14). Tension test results of standard 0.505-in. diam tensile bars containing welds compare favorable with base metal test results at room temperature and elevated temperatures (see Table 2). A limited number of fatigue specimens were tested, the results of which are equal to base metal.

Titanium Alloys

Many airframe companies are using titanium alloys in sheet and forged shapes as well as tubular sections. Welding is being done by resistance, flash, inert-gas tungsten-arc, etc.

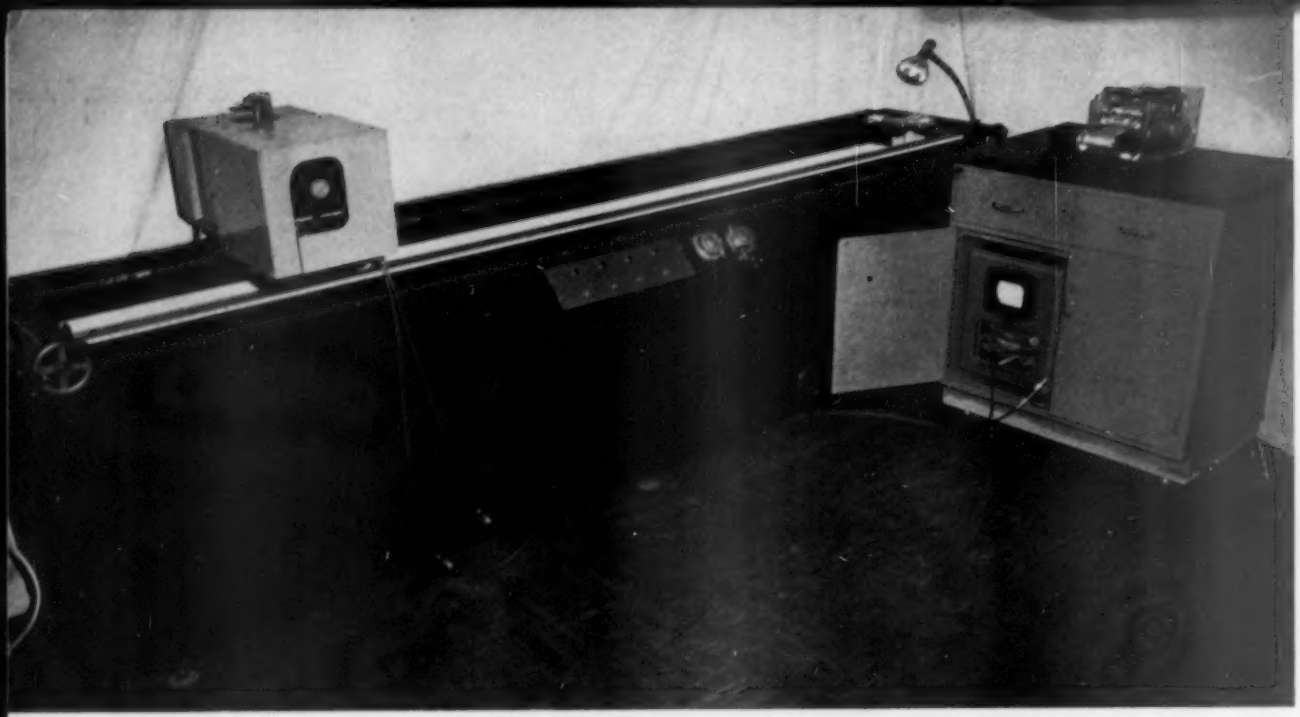
A most successful method of joining titanium tubular sections has been by pressure welding (see Figs. 15 and 16). Welds have been made in three titanium base alloys, two of which are heat treatable.

1. 3% Al, 5% Cr low carbon—not heat treatable.
2. 3% Mn complex.
3. 6% Al, 4% V (see Table 3).

For the nonheat-reatable 3% Al, 5% Cr alloy, the ultimate tensile strength of the weld exceeds that of the base metal; for the two heat-treatable alloys, 3% Mn complex and the 6% Al, 4% V, the ultimate tensile strength of the weld is approximately 3% less than the base-metal strength. Charpy impact data show that pressure-welded specimens have approximately the same values as base-metal specimens.

Conclusion

Pressure welding has played a major part in the fabrication of aircraft landing gear assemblies at our plant. At the present time, approximately 100 different sizes are qualified, ten of which are qualified in the high heat-treat range of 260,000–280,000 psi. This, the authors believe, gives quite a satisfactory picture that pressure welding is a most desirable means of joining alloy steel for aircraft use at any reasonable heat treat level.



Ultrasonic scanning and recording unit developed at Argonne National Laboratory

SOME NONDESTRUCTIVE TESTING METHODS FOR TESTING WELDS

The sensitivity, advantages, disadvantages and limitations of the various methods and techniques of nondestructive testing are discussed by the author

BY W. J. McGONNAGLE

Introduction

The term nondestructive testing is a general name given to all test methods which permit testing or inspection of material without damage to the material.

The essential parts of any nondestructive test are: (1) *application* of a testing or inspection medium; (2) *modification* of the testing or inspection medium by defects or variations in the metallurgical structure of the material; (3) *detection* of this change by a suitable detector; (4) *conversion* of this change into a form suitable for interpretation; and (5) *interpretation* of the information obtained. Interpretation is the most important step in the procedure. Since most nondestructive test results are indirect measurement, it is essential that the interpretation be made by an experienced person. The person interpreting the results sometimes determines the success or failure of a test method. In some cases, there may be a sixth step to consider, that is, convincing the supplier, fabricator or engineer that the interpretation of the results is correct.

The five essential parts listed above are reviewed in the two following examples. For example, if one inspects a piece of paper by holding it between a source of light and the eye, then (1) visible light is the inspection medium, (2) the intensity of the transmitted light is modified by any markings on the paper, (3) the human eye is the detector, (4) the nervous system and brain convert the impulses from the eye, and (5) the brain interprets the impulses from the eye. In the case of X-ray radiography, (1) the X-rays are the inspection medium, (2) any defect in the material being radiographed will modify the intensity of the radiation reaching the film on the opposite side of the test object, (3) certain silver-bromide emulsions are sensitive to X-rays and can be used as a detector, (4) the emulsions are

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capable of recording variations in X-ray intensity and by the proper developing procedures can be made to give a permanent record, and (5) interpretation is then a process of explaining variations in darking of the radiograph.

Table 1 shows typical defects and structure variables which can be found by nondestructive tests.

Nearly every form of energy has been utilized in nondestructive testing. Likewise, nearly every property of the materials to be inspected has been made the basis for some method of nondestructive testing. However, these test methods can be divided into the following rather well-defined groups: visual, pressure and leak, penetrant, thermal, radiography, acoustic, magnetic, electrical and electromagnetic.

Table 2 lists some of the factors which must be considered in selecting a nondestructive test.

Visual Inspection

Visual inspection is the most widely used nondestructive test. It is simple, easy to apply, quickly carried out and usually low in cost.

In visual nondestructive tests the object to be tested is illuminated with visible light. The object is then examined with the eye or by light sensitive devices such as photoelectric cells.

The human eye has excellent visual perception. However, it is of prime importance to have adequate lighting. The period of time during which a human inspector is permitted to work should be limited to avoid errors due to decrease in visual reliability and discrimination.

Optical aids such as lenses, mirrors, microscopes and telescopes provide a means of compensating for the limits of visual acuity of the human eye, by enlarging small discontinuities in materials. Enlarging projectors and comparators provide a means for improving viewing conditions for rapid inspection of small precision parts. Boroscopes permit direct visual inspection of the interior of hollow tubes, chambers and other internal surfaces. Photoelectric and other light sensitive systems can often be used to replace direct visual inspection and compensate for errors due to operator fatigue.

Table 1—Defects and Structure Variables Which Can Be Found by Nondestructive Tests

- A. Integrity
  - 1. Surface Flaws
    - (*a*) Cracks or Tears
    - (*b*) Shrinkage Cavities
    - (*c*) Misruns
    - (*d*) Inclusions
    - (*e*) Porosity
    - (*f*) Undercuts
    - (*g*) Inadequate Penetration
    - (*h*) Incomplete Fusion
    - (*i*) Flakes or Bursts
    - (*j*) Folds, Laps or Seams
    - (*k*) Laminations or Cold Shuts
    - (*l*) Blisters, Scabs or Pits
  - 2. Subsurface Flaws
    - (*a*) Cracks or Tears
    - (*b*) Shrinkage Cavities
    - (*c*) Misruns
    - (*d*) Inclusions
    - (*e*) Porosity
    - (*f*) Inadequate Penetration
    - (*g*) Incomplete Fusion
    - (*h*) Flakes or Bursts
    - (*i*) Laminations or Cold Shuts
    - (*j*) Lack of Bond
- B. Mechanical Properties
  - 1. Hardness
  - 2. Miscellaneous structure-sensitive or strain-sensitive properties, and sorting.
- C. Chemical Properties
  - 1. Carbon Content
  - 2. Miscellaneous analysis and sorting
- D. Dimensions
  - 1. Thickness
  - 2. Location or position of hidden components
- E. Surface Roughness
- F. Metallurgical Structure

Pressure and Leak Tests

In pressure and leak tests defects are revealed by the flow of gases or liquid into or through the defects.

The simplest test of this type is a hydrostatic test in which the pressure within the test object (hollow) is made greater than the external pressure. The presence of leaks is revealed by changes in pressure or bubble formation when the test object is immersed in water, kerosene, or similar liquid.

Table 2—Some Factors to Be Considered in Selecting Nondestructive Tests

- A. Material to Be Tested
  - 1. Ferromagnetic Alloy
  - 2. Nonmagnetic Light Alloy
  - 3. Nonmagnetic Heavy Alloy
  - 4. Nonconducting Coating on Metal Base
  - 5. Nonmagnetic Metal Coating on Ferromagnetic Metal Base
- B. Method of Fabrication
  - 1. Cast
  - 2. Wrought
  - 3. Powder Metallurgy
  - 4. Welded or Soldered
  - 5. Coating Process
- C. Geometry of Material
  - 1. Thickness
  - 2. Shape
  - 3. Surface Condition
- D. Defects Possible or Expected
  - 1. Type
  - 2. Size
  - 3. Location
- E. Sensitivity and Resolution Desired or Required
  - 1. Test Sample
  - 2. Destructive Tests
  - 3. Standards

Pressure and leak tests can be made more sensitive by using fluorescent liquids and penetrants, radioactive gas or liquids, gases such as freon, ammonia, sulfur dioxide and helium. Halogen sensitive leak detectors can be used with any gas that contains either chlorine, fluorine, bromine or iodine. Halogen gas concentration of one part per million can be detected or, in terms of leaks, such detectors can locate a leak so small that only one hundredth ounce of halogen gas will pass through the opening in a year. The halogen-sensitive element is a heated platinum surface. A fan is used to draw an air sample over the halogen-sensitive element. One precaution which must be observed is to keep the area in which the testing is being carried out free of vapors from halogen compounds.

Helium gas used in connection with commercially available mass spectrometer helium leak detectors gives a very sensitive leak test. Commercial helium leak detectors can detect the presence of one part of helium in 200,000 parts of air.

A technique that can be used to check the welds on a hollow vessel is to first evacuate the vessel and then con-

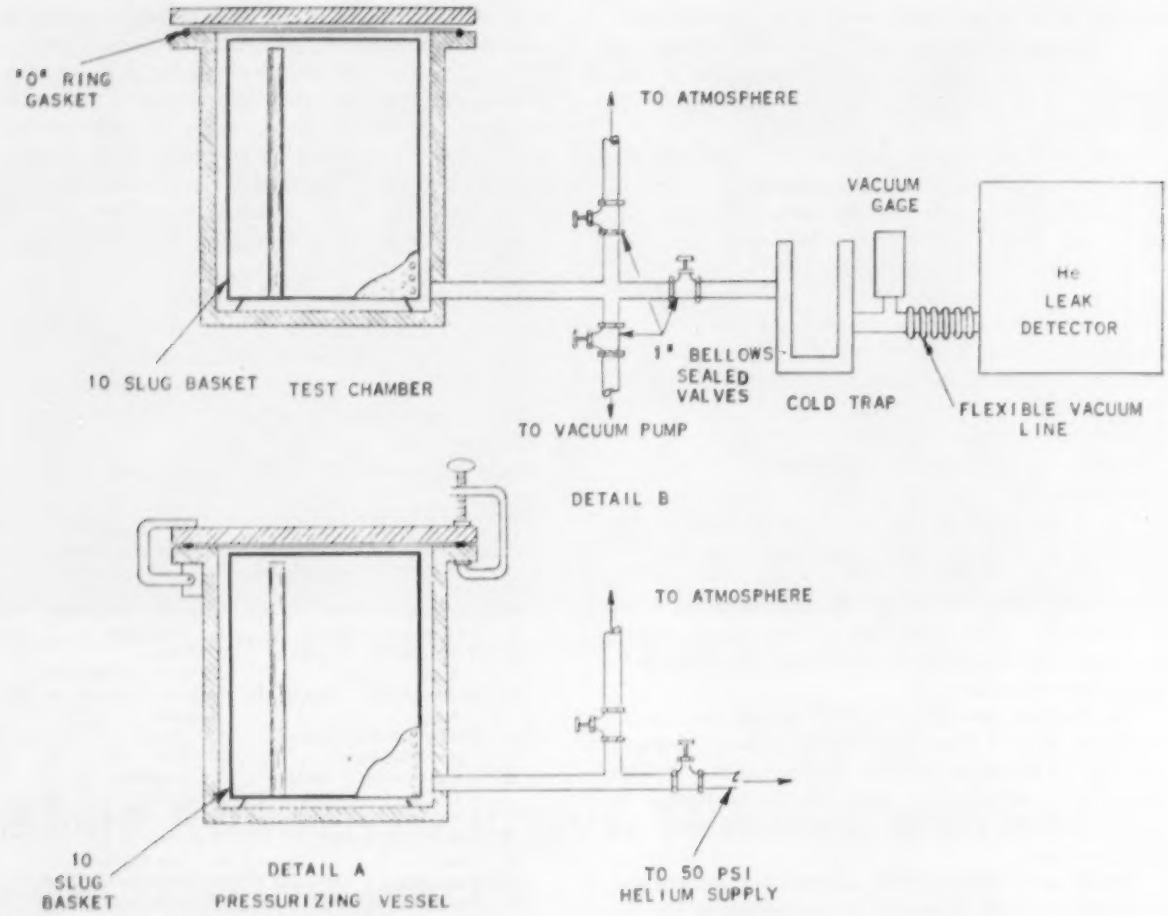


Fig. 1 Helium leak detector test apparatus

nect it to the helium leak detector. A fine jet of helium such as obtained from a hypodermic needle is moved over the surface of the vessel. Helium will be drawn into any hole through the walls and will register on the leak detector. A variation of this technique is to surround the test object with a helium atmosphere by enclosing the test object in some sort of gas-tight chamber, such as a plastic bag. A second technique is to build up an internal helium gas pressure and scan the surface with a "sniffer" connected to the helium leak detector. A third technique can be used with solid samples and for detecting the presence of minute holes, cracks, fissures, etc., in welds.

In applying the latter technique, the test object is first placed in a helium-pressurizing vessel and exposed to a helium atmosphere (detail A, Fig. 1). The sample is removed from the pressurizing vessel and transferred to a second chamber which is connected to a vacuum pump and helium leak detector (detail B, Fig. 1). This chamber is evacuated to a pressure of approximately 150 microns, then the throttle valve on the leak detector is opened, and the relative quantity of helium released is read on the leak-indicating meter. Table 3 shows typical helium leak results on a group of welded samples. The two samples having excessive response were found to have defective welds. Dirt, oil and scale on the test object cause large response when using this technique but samples that have had an acid dip are sufficiently clean for testing. A large open cavity (such as cracks in welds which are visible to the eye) does not produce a noticeable response because helium is not retained long enough after the fuel element is removed from the helium pressurizing vessel.

Penetrant Inspection

Penetrant inspection is a quick and easily applied nondestructive testing method for the detection of sur-

Table 3—Typical Helium Leak Test Results

Leak detector reading (arbitrary units)	*No. of welded samples in range*
0.0– 0.5	48
0.6– 1.0	5
1.1– 1.5	18
1.6– 2.0	19
2.1– 3.0	30
3.1– 4.0	3
4.1– 5.0	3
12.0	1
14.0	1

face discontinuities. Penetrant inspection methods are applicable to all metals as well as glazed ceramics, plastics and other nonporous materials.

The basic principle utilized in penetrant inspection is that the penetrant is drawn into surface discontinuities by capillary action. The presence of the penetrant in the discontinuities is revealed by the use of a developer.

The technique consists basically of:

(1) cleaning the surface—surfaces to be inspected must be free of any grease, oil, scale or other foreign materials which would clog surface openings;

(2) applying the penetrant—the penetrant can be applied to the part by brush, spray or immersion; the required penetration time may vary from 1 to 10 min. or longer depending on the penetrant, material and type of defect;

(3) removing the excess penetrant—after the penetrant has been in contact with the surface long enough for the penetrant to enter the discontinuities in sufficient quantity, the excess penetrant remaining on the surface is removed using a suitable solvent;

(4) applying the developer—the developer is used to draw the penetrant from the discontinuities by a blotting action and spread it on the surface of the piece for a short distance on each side of the defect;

(5) inspection and interpretation—this is the most important part of the procedure.

Penetrants can be divided into two types—dye penetrants and fluorescent penetrants. Dye penetrants are to be viewed under white light while fluorescent penetrants are to be viewed under black light (3600 Å). When using dye penetrants, discontinuities are indicated by red dots or lines on a white background, and when fluorescent penetrants are used the discontinuities are indicated as glowing yellow, green dots or lines against a dark background.

Thermal Test

The basic principle of thermal tests is to apply heat to the test object and measure the resulting temperature conditions. The heat may be applied by direct thermal contact with a heat source, by electric current heating or induction heating. The resulting temperature indications may be detected by the use of temperature indicating substances such as "sharp" melting point chemicals, temperature sensitive paints, temperature sensitive phosphors, infrared detectors, thermocouples, bolometers and resistance thermometers.

One thermal test that has been widely used in testing reactor components is the so-called "frost test." The principle of the frost test is to coat the test piece uniformly with acenaphthene, a frosty appearing compound and then apply surface heating by induction. Areas of poor heat transfer become hotter than the rest of the surface. If the amount of heat applied is properly adjusted, the coating will melt on poorly bonded areas but not on the rest of the sample. Typical frost test results are shown in Fig. 2. Commercial induction units can be used to supply the necessary heat. For cylindrical shaped samples a single turn inductor can be used and for flat samples a rectangular shaped inductor can be used.

The thermal tests can be made more sensitive by using a temperature-sensitive phosphor. The phosphor is so temperature sensitive that localized small increases in temperature reveal themselves as relatively dark areas. The use of the phosphor thus makes it possible to observe a detailed temperature distribution on a surface. This method has been used for testing for lack of bond in a metal laminate. The disadvantages of the use of this phosphor is that the test object must be viewed under ultraviolet light and the color change is not permanent.

Radiography

Radiography is a nondestructive test method which uses penetrating radiation such as X-rays or gamma rays. The intensity of the radiation is modified by passage through or reflection from the material and defects in the test object. The differential absorption of the radiation is a function of the density, thickness and kind of material through which the radiation is traveling.

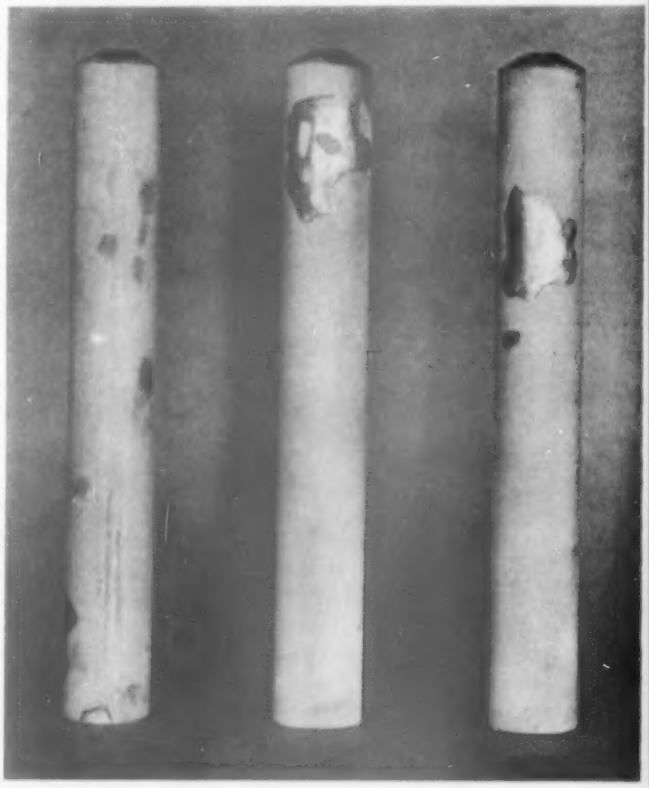


Fig. 2 Frost test results

Two dissimilar materials can be detected in radiography because of a difference in the absorption on the X-rays. Generally stated, to preserve sensitivity, it is best to use the softest radiation that gives the required

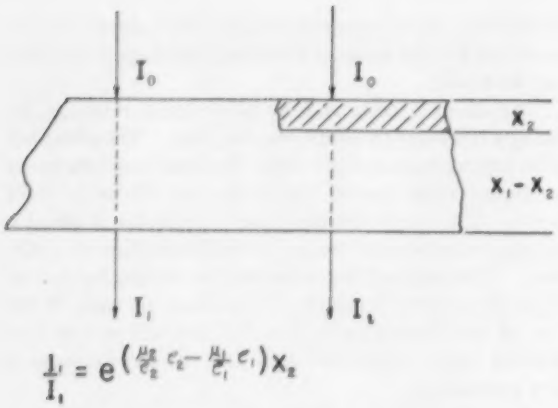


Fig. 3 Differential x-ray absorption

μ_1/ρ_1—Mass. absorption coefficient of one material
μ_2/ρ_2—Mass. absorption coefficient of other material
ρ_1—Density of one material
ρ_2—Density of other material

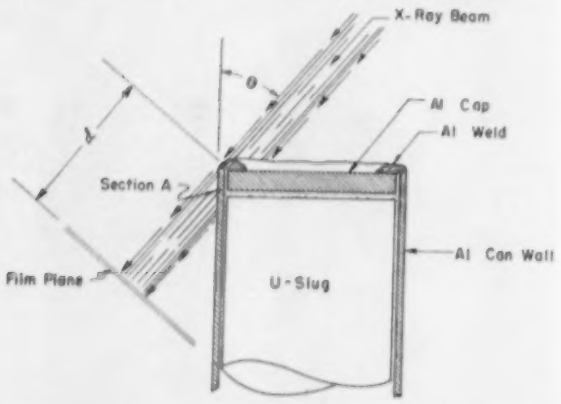


Fig. 4 Schematic diagram of end-weld closure and experimental arrangement

penetration. The ratio of the intensity of the beam through the same thickness of a two-material region is a measure of the sensitivity of method. The greater the value of this ratio, the greater contrast on the radiograph and the smaller will be the thickness of foreign material that can be detected. The ratio of these intensities is an exponential function of the difference of the product of the mass absorption coefficients and the density of each material. This ratio is given by the following expression (see Fig. 3):

$$\frac{I}{I_t} = \exp\left(\frac{\mu_2}{\rho_2}\rho_2 - \frac{\mu_1}{\rho_1}\rho_1\right)x_2$$

Many sources of radiation are available today. Table 4 has been prepared, listing a number of these sources and specifying the thickness range (of aluminum and steel) in which each source finds its greatest usefulness.

When an X-ray beam strikes a film usually less than 1% of the X-ray energy is absorbed by the film. By use of calcium tungstate and lead screens it is possible to make use of the wasted energy and this reduces exposure time. The calcium tungstate screen intensifies because of the blue flourescent light it emits when struck by X-rays. The lead screen intensified because of the secondary electrons ejected by the X-rays.

One limitation of the radiographic method of nondestructive testing is the detection of a thin, flat discontinuity, such as a crack. If it is oriented so that the radiation passes along one of its larger dimensions, it may be detected, but if it is oriented so that the radiation passes only through the smallest dimension in traversing the object, a record could be expected only if the width were at least a few per cent of the total object thickness. In some cases, it may be advisable to make more than one exposure irradiating the object from different directions. Many of the radiographic techniques which are used in industry also find application in testing of reactor components.

One technique which is of special interest in testing for defects in closure welds will be discussed. The experimental setup is shown in Fig. 4. Since the region being radiographed varies in thickness, a double film technique was used. Dosimeter film packs which contain both a slow and fast film are well suited for this application. The fast film records where the intensity is low and the slow film records the outer edge. Figure 5 shows defects found by radiography in end weld closures.

Figures 6, 7 and 8 show typical pipeline welds. The radiograph in Fig. 6 shows a distinct line indicating lack of fusion at the root. The distinct blur in the region labeled *B-B* indicates a lack of fusion of some magnitude. A longitudinal section made at *B-B* showed the general lack of penetration indicated on the radiograph. A transverse cross section showed the extent of the defect.

The weld shown in Fig. 7 was made as near perfect as possible. Eight holes of various diameters were drilled into the pass immediately under the cover pass.

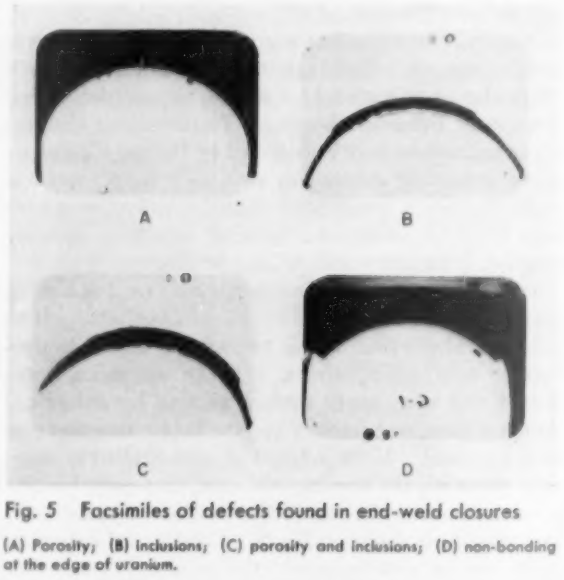


Fig. 5 Facsimiles of defects found in end-weld closures

(A) Porosity; (B) inclusions; (C) porosity and inclusions; (D) non-bonding at the edge of uranium.

Table 4—Radiographic Sources

Source	Practical thickness limits, in. Steel	Aluminum
50-kv X-rays	0.005–0.025	0.080–0.500
100-kv X-rays	0.040–0.190	0.200–1.00
150-kv X-rays	Up to 1	Up to 5.00
250-kv X-rays	Up to 2.00	1–8
1000-kv X-rays	1–5	1–12
2000-kv X-rays	1–8	...
24-mev Betatron	2–20	...
Radium	2–6	...
Cobalt 60	2–6	...
Iridium 192	$^3/_8$–$2^1/_2$	Above 1

An attempt was made to burn these out with an exceptionally heavy pass. Longitudinal section showed the drilled holes completely devoid of metal. This radiograph confirms the theory that succeeding passes cannot wash out holes to a satisfactory degree and a determined effort must be made to repair these defects.

The cover bead in Fig. 8 is very good. The arc track next to the weld is readily identified on the radiograph. The root bead in this section is just drawn tight enough together that full penetration can no longer be attained. The radiograph shows the partial lack of a root bead, but no indication that lack of penetration exists. More noticeable in this radiograph are the

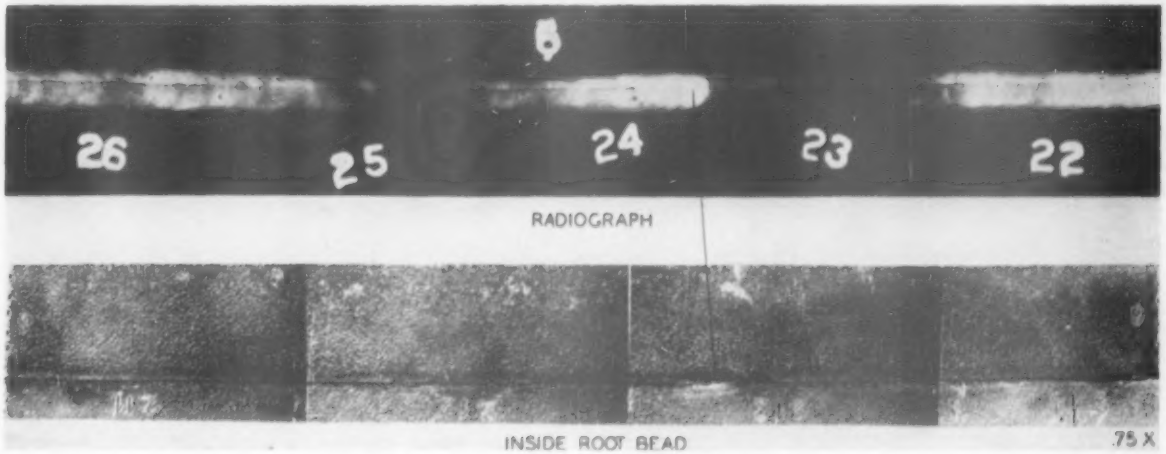


Fig. 6 Radiograph of pipe-line weld (Reduced by 25% upon reproduction)

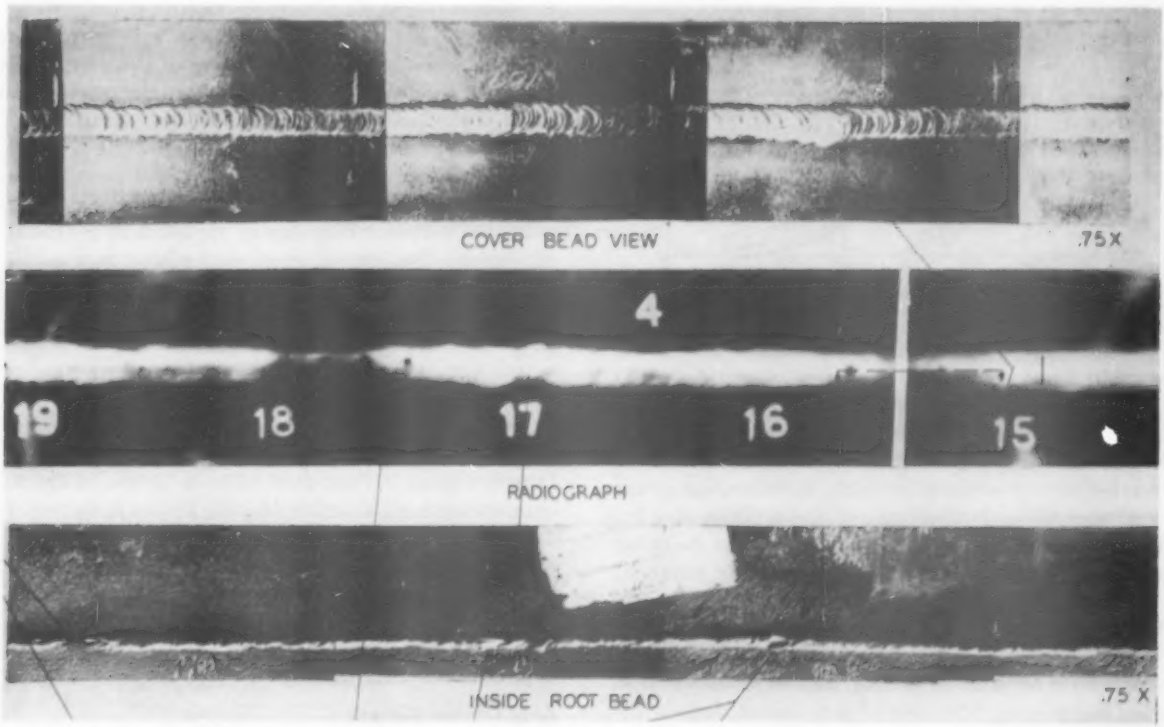


Fig. 7 Radiograph of pipe-line weld (Reduced by 25% upon reproduction)

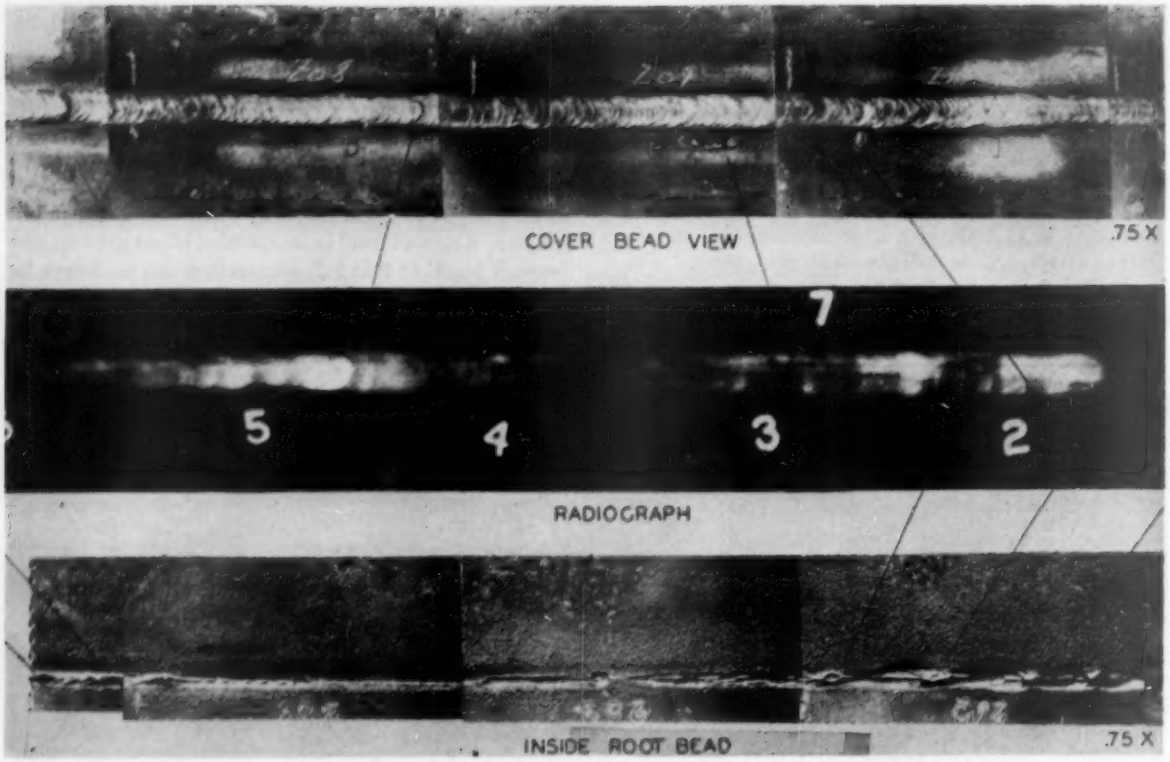
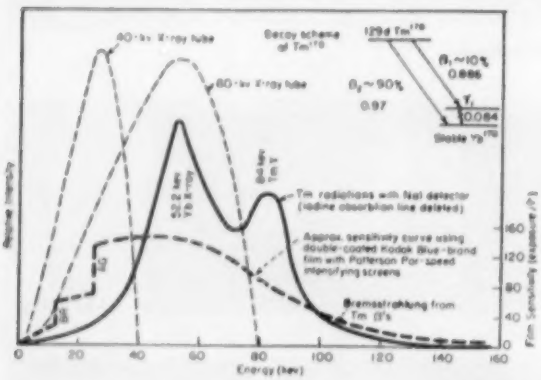


Fig. 8 Radiograph of pipe-line weld (Reduced by 25% upon reproduction)


80-kv X-ray tube
Decay scheme of Tm170
129d Tm170
80-kv X-ray tube
0.97
0.084
Stable Yb170
52.2 kev Yb X-ray
Tm radiations with NaI detector (iodine absorption line deleted)
Approx. sensitivity curve using double-coated Kodak Blue-brand film with Patterson Par-speed intensifying screens
Bremsstrahlung from Tm β's
Energy (kev)

RADIATION ENERGY SPECTRUM that is comparable to that of 80-kv X-ray tube and matches sensitivity peak of film. Intensity is lower than that of X-ray tube, but usefulness of thulium unit is shown by . . .

Fig. 9 Spectrum of Thulium 170

slag inclusions and slag stringer, which occurs as a dark line in the radiograph immediately above arc track.

Longitudinal sections made at various areas in the weld show these slag pockets and also a dispersal of gas pockets. These longitudinal sections showed the depth of the voids and the accompanying very dirty metal.

Figure 9 shows the energy spectrum of Thulium 170 which has recently been made available for radiography by the Argonne National Laboratory. The energy spectrum is comparable to that of an 80 kv X-ray tube.

Electrical Methods

Electrical resistance methods of nondestructive testing are based on the principle that the electrical resistivity in the immediate neighborhood of a defect differs from that in solid metal. With a metal sample of uniform dimensions, carrying electric current there is a fixed potential difference between any two points at a fixed distance apart. The presence of a defect will increase the potential difference between the two points. Clean, scale-free bare metal surfaces and pressure contacts are required to avoid contact overheating or burning of the sample. Surface contact resistance is an important factor in such tests and the surface contact resistance may cause a greater variation in potential difference. The special electrodes shown in Fig. 10 have been designed to reduce the disturbing effect of surface contact resistance to a negligible factor. In these electrodes, the current electrode completely surrounds and is electrically insulated from the potential electrode.

Another technique that can be used is to make the test object part of a Wheatstone Bridge, or a Kelvin Double Bridge. The initial balance of the bridge is obtained by using a sample which is known to be free of defects.

Ac or dc can be used in electrical tests. The ac gives better sensitivity for surface cracks while dc gives good results in showing the presence of deeper defects. The electrodes can be placed on the same sides or on opposite sides of the test object.

Eddy Current Methods

Nondestructive testing using eddy currents is based

on the principle that, when a coil carrying alternating current is brought near a metal specimen, eddy currents are induced in the metal. The induced eddy currents are confined to the surface layers of the specimen. The depth at which the current has decreased to 37% of its value at the surface is called the "depth of penetration" and is given by the following:

$$S = 1980 \left(\frac{\rho}{\mu f}\right)^{1/2}$$

where

S = depth of penetration, in.
f = frequency, cps
μ = permeability (= 1 for nonmagnetic materials)
ρ = resistivity, ohm cm

The above expression applies strictly to a plane solid. However, it may be extended to conductors of other shapes as long as the value of (S) is much smaller than the curvature of the surface.

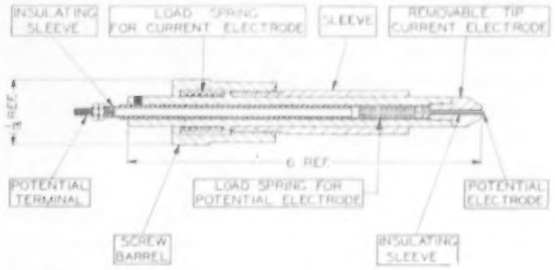


Fig. 10 Section through electrode potential—electrode

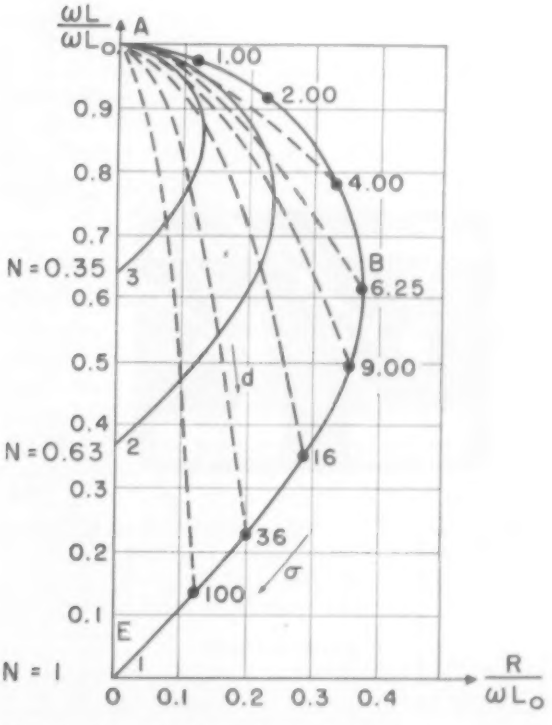


Fig. 11 Normalized impedance plane curves

The eddy currents induced in the metal set up a magnetic field which opposes the original magnetic field. The impedance of the exciting coil or any pickup coils in close proximity to the sample is affected by the presence of the eddy currents in the metal. If the path of the eddy currents is distorted by the presence of a defect, the apparent impedance of the coil is different than when no defect is present. This change in impedance can be measured and can be used to give an indication of defects or differences in physical structure.

The impedance due to the presence of the induced eddy current can be resolved into two components, an inductive component and a resistive component. The inductive component depends primarily on the space relationship of coil and specimen. The resistive component depends primarily on conductivity. The impedance diagram for the case in which the coil surrounds a solid metal rod is shown in Fig. 11. The impedance diagram can be used to discuss all eddy current inspection techniques. The dashed curves indicate how the impedance changes when specimens of the same conductivity but different diameters are placed in a coil. The solid curves indicate how the impedance of the coil changes when specimens of fixed diameter but different conductivity are placed in the coil.

Two types of coils can be used. A concentric coil pickup and a point probe. The concentric coil type of pickup encircles the sample and "looks" at the integrated resistivity of an annulus of the sample having a width equal to the effective width of the coil. The point probe "looks" at an area essentially equal to the area of the probe. The configuration of the exciting and pickup cores can be varied to fit different test conditions and samples.

There are a number of eddy current instruments available commercially. Although they differ somewhat in circuitry and sensitivity the fundamental principle of operation is the same.

One of these eddy current instruments was used to examine bare uranium rods with naturally occurring cracks, seams and porous areas. It was found experimentally that cracks in uranium were detected using a frequency of approximately 6.5 kc. Moreover, barely discernible separations give indications comparable to those obtained from gross cracks. The results obtained from testing five rods containing cracks is shown in Fig. 12. A rod, free of cracks, has been included in Fig. 12 for comparison purposes. The marked difference between the standard rods or between the cracked and uncracked samples is clearly evident. The rod designated by the letter B gave a peak indication at two places along the rod. One indication was due to a $1^3/_8$-in. longitudinal surface crack. There was no visual surface defect, however, to account for the other indication. The rod was then sectioned transversely at this position and seven subsurface cracks were found. Three of these appeared to start at or near the uranium surface, although no flaw could be detected by careful visual examination before sectioning. All the cracks

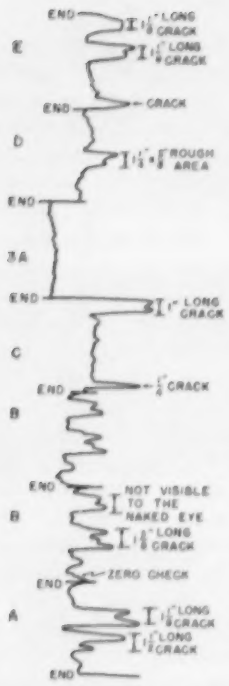


Fig. 12 Eddy current record

were entirely below the surface and were visible to the naked eye in the transverse section.

Ultrasonics

Ultrasonic waves can be used for detecting flaws in materials which are capable of transmitting electric vibrations. The ultrasonic waves are produced by a quartz crystal or barium titanate transducers which are devices used to convert the electrical oscillations of a radio frequency generator into mechanical vibrations or for the reverse process of converting mechanical vibrations into electrical signals.

The physical laws of acoustics which apply at audible frequencies also apply at ultrasonic frequencies. However, certain phenomena which occur in the ultrasonic range are not usually observed in the audible range. Due to their short wave-length ultrasonic waves tend to travel in straight lines. Ultrasonic waves are not reflected effectively by objects having dimensions less than the wave length of the ultrasonic waves.

An ultrasonic beam impinging on an interface between two media is partly reflected and partly transmitted in accordance with well-known laws. The characteristic which determines the amount of reflection is known as the acoustic impedance (ρV) and is the product of the density of the media (ρ) and the velocity (V) of the waves in the media. The ratio of the reflected energy (R) to the incident energy (R_0) is given by:

$$\frac{R}{R_0} = \left[\frac{\rho_1 V_1 - \rho_2 V_2}{\rho_1 V_1 + \rho_2 V_2}\right]^2$$

The subscripts 1 and 2 indicate the two media. From this expression, it can be seen that at an air-solid interface nearly 100% of the ultrasonic energy is reflected. Consequently, it is necessary to use a liquid couplant such as water, oil or glycerin to transmit the acoustic energy from the transducer into the sample. This equation also shows why ultrasonic techniques are good for locating nonbonded areas.

In order to obtain the maximum sensitivity and resolution the ultrasonic beam should have as small a cross section as possible. There are two ways in which this can be done: by the use of absorption masks or by the use of lenses. Absorption masks are made by covering the transmitting transducer with an absorbing material through which a hole has been drilled. The principle of physical optics carries over into the field of image formation with acoustic lenses and can be used in designing acoustic lenses. Lenses have the added advantage of concentrating the energy.

The higher the frequency the smaller the defect that can be located; however, as the frequency is increased, the penetration of the beam is decreased and consequently a practical limit is set to the frequency that can be successfully used. The decreased penetration is due to the scattering of the waves by the grains of the metal. This effect is particularly large when the wave length of the waves approaches the grain size in the metal.

Two different ultrasonic techniques are in common use today. These are: pulse echo and transmission.

In the pulse echo technique a pulsed ultrasonic beam is sent into the sample. The beam is reflected from the opposite side of the sample as well as from any discontinuity or defect. In the echo which is displayed on an oscilloscope screen a defect can be recognized by the relative position of its echo. The principle of this technique is shown in Fig. 13. In a variation of this technique the pulsed ultrasonic beam is projected into the sample at an oblique angle to the surface. The beam travels in a zigzag path between top and bottom of the sample as shown in Fig. 14. This technique is sometimes referred to as a shear wave or angle beam technique.

In the transmission technique, a continuous wave or a pulsed ultrasonic beam travels through the sample and the transmitted energy received by a second transducer. The energy lost by the beam in traveling through the

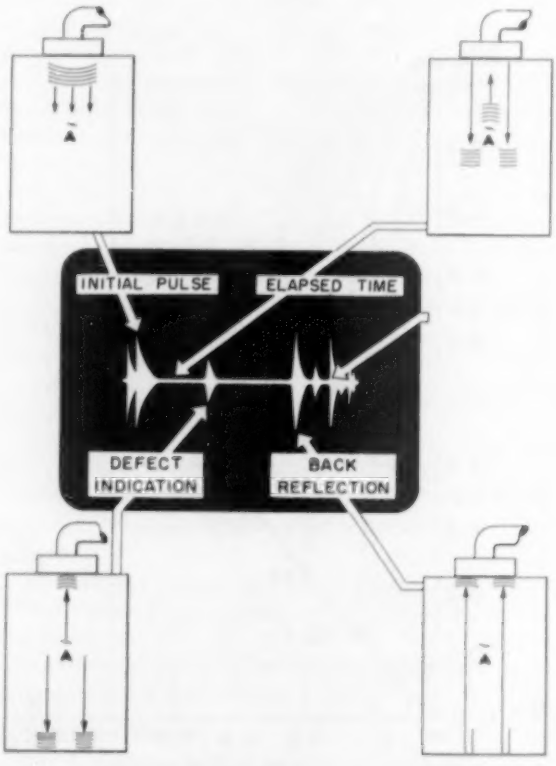
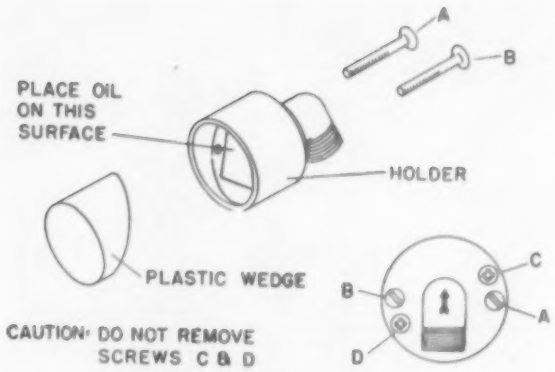


Fig. 13 Principle of operation



Showing construction of a typical angle beam searching unit.

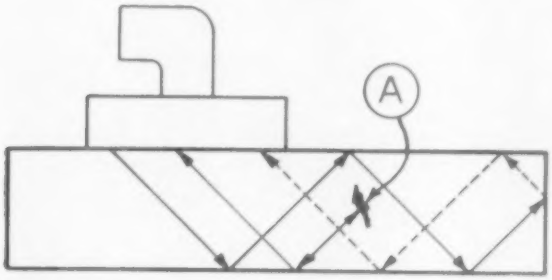


Fig. 14 Shear wave propagation and transducer

The path of the sound beam and its reflection from an internal defect in plate is visualized above.

sample reveals existing flaws and their extent. If continuous ultrasonic waves are used, it is necessary to prevent the occurrence of standing waves.

The shear wave technique is being used to ultrasonically examine weldments. The technique for examining welds is illustrated in Fig. 15.

Figure 16 shows an electronsensitive paper recorder developed at Argonne National Laboratory for testing reactor fuel elements by the thorough transmission technique. Figure 17 shows a typical electronsensitive paper record made using a "synthetic defect" and the ultrasonic transmission technique.

Conclusion

Generalizations about the selection and application of nondestructive tests are not of too much value since each actual case is a specific problem and undoubtedly has some features about it which make it unique and different from other applications. The various nondestructive tests are not competitive but rather supplement each other. Each nondestructive test is best suited for detecting certain types of flaws. An understanding of the basic principles of each type of test is essential if the possibilities, advantages and limitations of each method are to be appreciated.

Acknowledgment

The author wishes to acknowledge the cooperation of A. G. Barlow, Natural Gas Pipeline Co. of America, in providing Figs. 6 through 8.

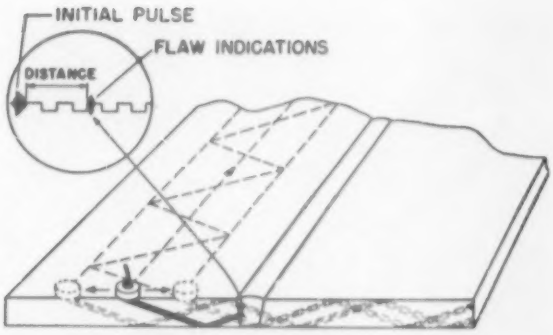


Fig. 15 Weld inspection using shear waves

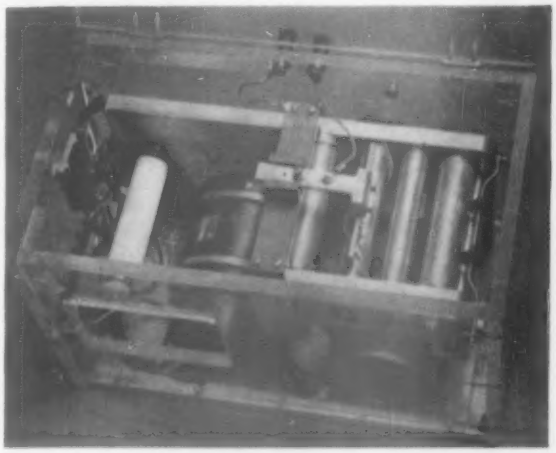


Fig. 16 Electrosensitive paper recorder

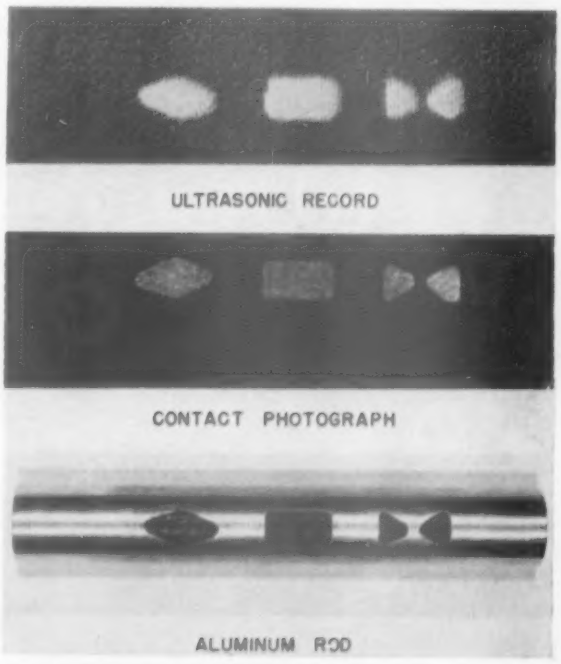
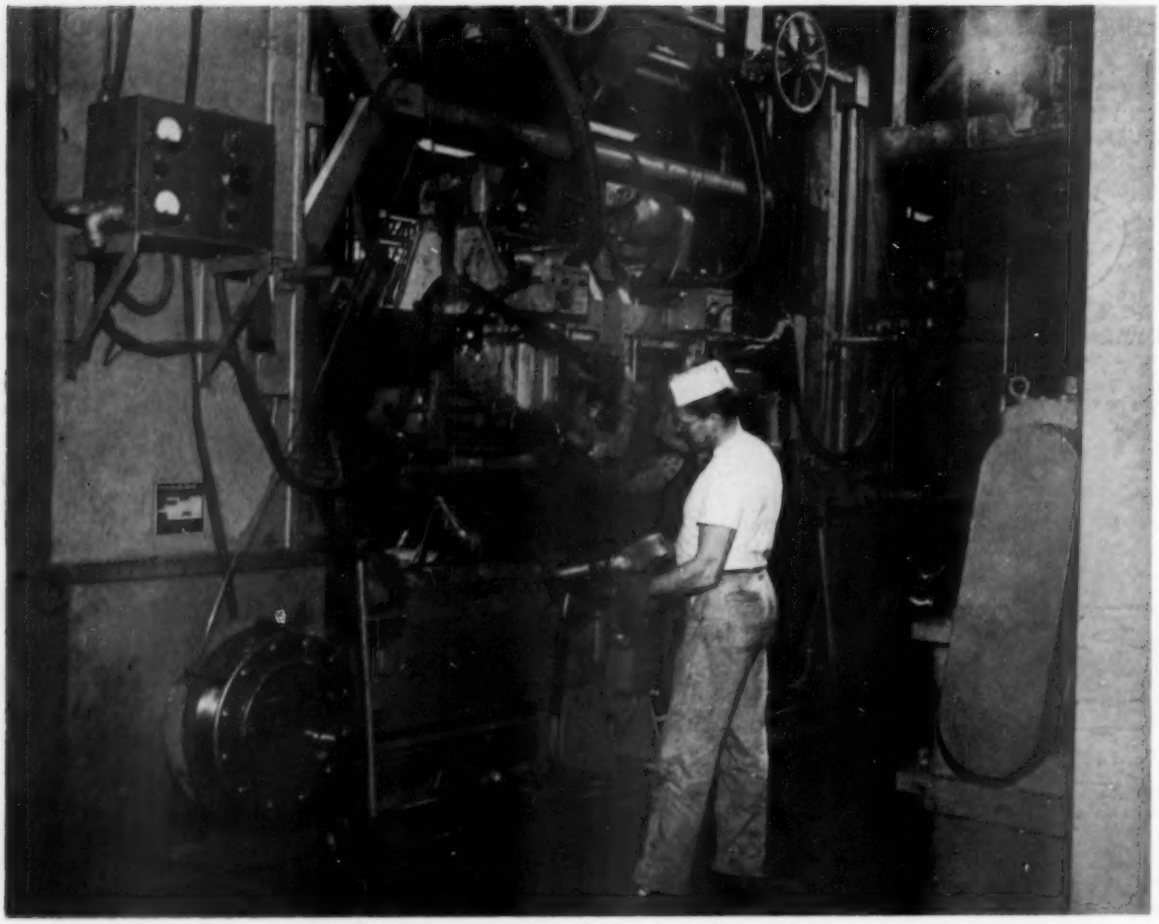


Fig. 17 Electrosensitive paper record



Automatic machine is making four 3 o'clock welds simultaneously on axle housings

NUMEROUS AUTOMATIC SUBMERGED-ARC WELDS IN NEW AUTOMOBILE AXLE HOUSING

Some are straight line, some circular, some arc shape and one follows a flattened ellipse. Assembly is sturdier and heavier because of higher power engine

BY A. F. BOUCHER

Marked extension of automatic submerged-arc welding has taken place in producing rear-axle housings and some other components of automobile chassis at the Buick Motor Division, General Motors plant, Flint, Mich. Several components of earlier models of cars were similarly welded, but many new machines have been added and some older ones have been altered to meet changes in the design of weldments.

Of all the chassis weldments produced, the rear-axle housing is the largest and has undergone extensive changes in design, largely because a more powerful engine imposes higher stresses. This housing is composed of heavier stampings and the banjo shape has been altered from circular to a flattened and near ellip-

A. F. Boucher, is District Engineer, Lincoln Electric Co., Detroit, Mich.

tical shape. Formerly, the end flanges were hot formed and their hubs were joined to the outer end of the tubular portions extending from the banjo by automatic submerged-arc butt welds.

In the new design, the flanges are cold drawn and are telescoped over the tube ends when pressed into place. Then, circular fillet-type, submerged-arc welds are made in joining the ends of the flange hubs to the tubes. These changes involve alterations in welding machines and procedures and the higher output requires more machines. Many new arc welders are employed to fasten brackets to the housings. Several applications, calling for a high degree of flexibility and precise control use a newly developed automatic head.

Three O'clock Welding

Largest among the welding stations are five installations (see lead photo) of special fixtures and machinery of which two are new and the other three involve some modifications as compared with the older design. Each of these machines makes four simultaneous longitudinal 3 o'clock arc welds that join the two stamped half housings. These welds measure 20 and 21 in. long, respectively, and each extends from the edge of the banjo bore to the end of the tubular portion. Each is made by an automatic head that is traversed along ways above the fixture that clamps the two halves together.

Edges of the half tubes are coined so that they are straight and insure good fit-ups, which is important for uniform welds. Fixtures have ledges just below the welds onto which the granular flux is fed in front of each electrode which is nearly horizontal. Flux covers the arcs and that which is not fused falls off, is sifted on shaker screens, and is elevated for reuse; new flux for makeup is added as needed. Wire of $^1/_8$ in. diam is fed, of course, from four reels.

Four of the five machines are placed in pairs, so that they are face to face, with enough room between them for loading, this permitting one man to operate two machines, one of which is unloaded and reloaded while the other runs through its automatic cycle. Each machine can make the four longitudinal welds on 50 housings in one hour.

As soon as the welds are completed, with heads traveling at 67 ipm, the fixture unlocks and the weldment is removed. Heads then move back toward the center and stop where they are in position to start new welds when the next housing is loaded. Formerly, a hubbed flange was clamped at each end of the housing in the fixtures of these machines and the arc welds were continued over the hubs a short distance to tack the hubs to the ends of the tubes. Then, the housing was shifted to an adjacent machine to make the circular welds for permanent fastening of hubs to tubes.

Now, the flanges are not applied in these welding stations but are pressed in place over tube ends in new equipment, after the ends of longitudinal beads have been sheared off flush with the tube walls and the tube ends have been stuck in dies to insure cylindrical ends that will make a good press fit in flange hub bores.

Circular Fillet Welds

After the ends of housing weldments are sized, these weldments are conveyed to a group of five welding stations, each of which has two automatic heads set so that electrodes are inclined about 25 degrees. Each machine has a fixture in which the weldment is set and fastened by a clamp that centers the banjo and also clamps one banjo face against a mating flat. This insures correct location both endwise and at a correct angle relative to a flat on the edge of each flange, one flange being put in place at each end of the housing.

When so loaded, plungers, operated by air cylinders at each end, press the flange hubs over the ends of the housing. This is done with an air supply at 60 psi. Flange faces have to be at a fixed distance from the banjo center and this is controlled by limit switches so set that, when the correct location is attained, a solenoid opens a valve to drop cylinder pressure to 15 psi.

At this instant, the two electrodes are fed down, arcs are struck and rotation starts and proceeds until the two circular fillet welds are completed, with sufficient flux to cover the arcs being fed automatically through tubes above the two electrodes. As weld overlaps of $1^1/_4$ in. are specified, tools are arranged to feed in automatically and scrape off flux that has fused where the overlaps must come.

Upon completion of the two welds, which are made simultaneously, current is shut off, electrodes withdrawn, flux feed stops and the weldment is rotated back to starting position. Thereupon, it is unlocked, unloaded and the fixture is reloaded, ready to complete the cycle. Electrodes are of $^1/_8$-in. wire and all agglomerated flux is used. Current is supplied by two 600-amp d-c generators for each machine at 27 v and 500 amp, the high current insuring good penetration. Ex-

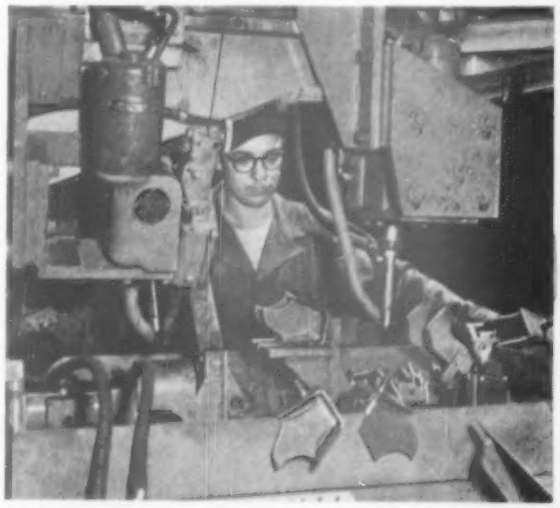


Fig. 1 One of two automatic welding stations that make the joints in which two stampings are fastened together to form the brackets to which strut rods and shock absorbers are fastened

cess flux is recovered, sifted and reused. As with the machines at the first welding station, these are set in pairs operated by one man, one being unloaded and reloaded while the next one runs through its automatic cycle. Each of the five machines makes two circular welds on 50 housings per hour.

All of the d-c generators and exciters for the above-mentioned machines are located in a well-ventilated and dust-free room in a balcony from which leads extend to control panels at the machines. In this location, the generators remain clean and maintenance costs are reduced; in addition, maintenance is facilitated when it is needed.

Welding Bumper Brackets

Among several axle-housing brackets is the bumper bracket that also anchors strut rods and shock absorbers. Pairs of stampings for these brackets are joined on three duplicate welding fixtures, one of which appears in Fig. 1. Each of these has three heads, of which two, feeding $^{1}/_{8}$-in. electrode wire, produce, at the same time, two welds parallel to the housing axis. The third head produces, subsequently, a weld at an angle to the axis, using $^{3}/_{32}$-in. wire. Each head has its own flux feed, but all are supplied with flux from a central hopper to which unfused flux is returned after sifting.

Brackets are loaded by hand, but are positioned by fixtures in which the components are air clamped, after which the welds are made automatically. At the end of the cycle, the weldment is automatically unclamped. Parts reach these and other welders via a monorail chain to which they are returned after welds are completed.

Four other fixtures one of which is shown in Fig. 2 built especially for the job, make welds on bumper brackets having curved faces that fit tubular extensions and are welded along circular arcs. All four machines have the heads arranged so that they rock around the edges of the brackets, the $^{5}/_{32}$-in. electrode wire being fed in at a 45-deg angle directed toward the corners in which the fillet welds are laid down. Housings and brackets are air clamped in position, after which the pressing of a start button causes the four welds to be made automatically and simultaneously.

Two more fixtures, Figs. 3 and 4, are arranged to make longitudinal fillet welds along the edges of bumper brackets, the heads being arranged to swing down to bring electrodes into proper angular position and then to traverse automatically after the housing and brackets are air clamped in a fixture. Wire $^{5}/_{32}$ in. in diam is used and feeds through guides in the center of the tubes; the latter also feed flux as needed.

Elliptical-Shaped Heads

Covers for the rear face of the axle-housing banjos have to be welded in place and these welds are made in machines such as shown in Figs. 5 and 6. In these machines, the axle housing is rotated slowly in an inclined plane about the banjo axis, which is at right angles to the longitudinal axis of the housing. As the cover is

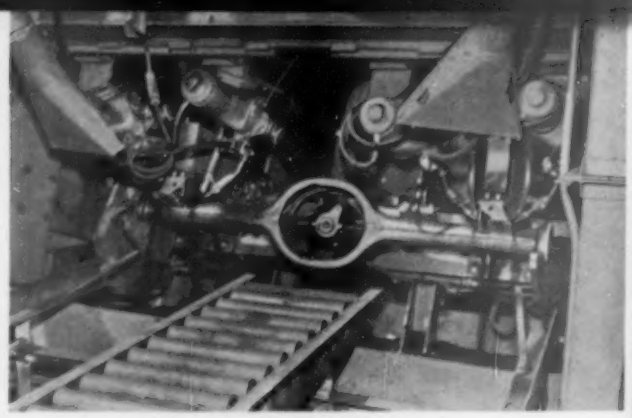


Fig. 2 Unit that fastens bumper brackets to axle housings, making four welds at a time along arcs where the bracket legs fit the tubular extensions. Heads are rocked through an arc as welds are made

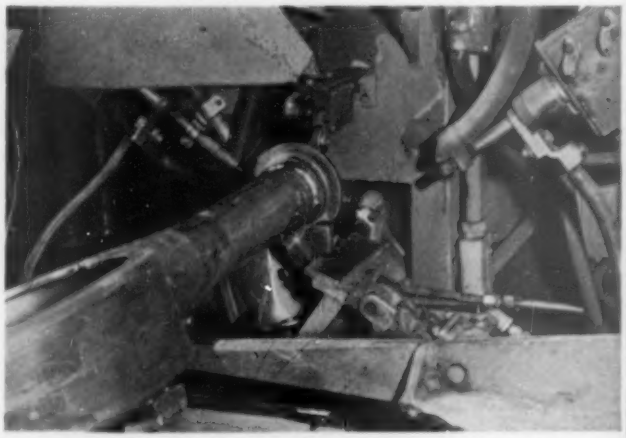


Fig. 3 In this machine, longitudinal welds are made automatically to fasten straight edges of bumper brackets to the housing's tubular extensions. This view shows the heads retracted after the welds are made

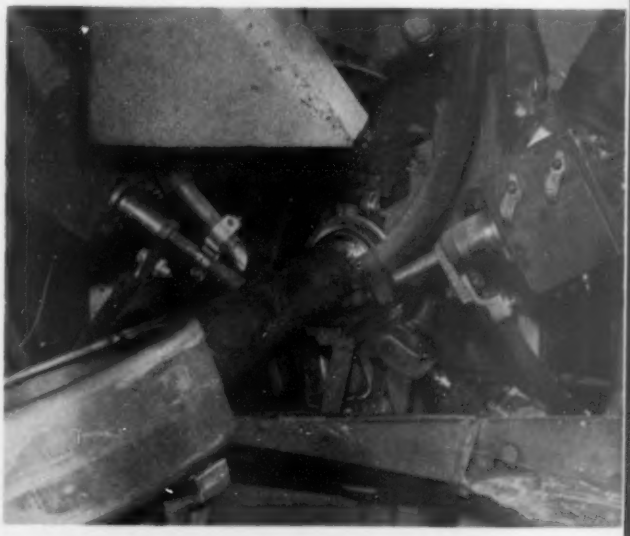


Fig. 4 Same setup shown in Fig. 3 but with the heads shown in welding position. Both heads are traversed so that the electrodes follow straight lines along the edges of the bracket

Fig. 5 Machine with an axle housing in position for making the automatic arc weld that fastens the cover to the back face of the banjo, using a new type automatic head feeding $^{5}/_{32}$-in. electrode wire

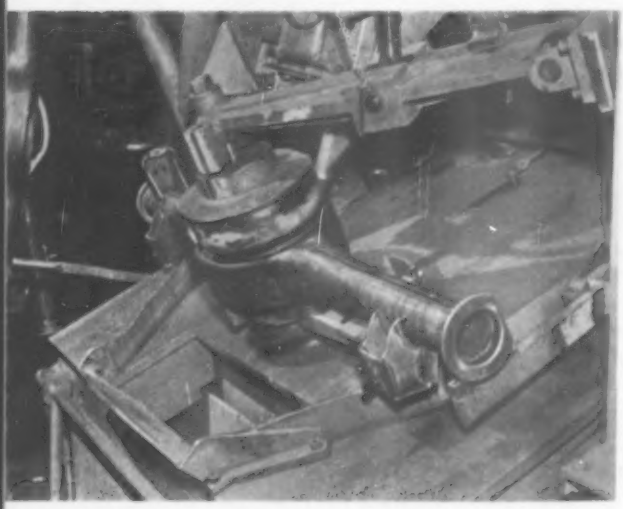


Fig. 6 Housing as it appears after the circular weld fastening the cover to the banjo has been completed and the clamp and head are withdrawn. During the weld, the axle housing rotates about the banjo axis

Fig. 7 One of the two new machines that fasten the hub of a stamped and flanged bell to one end of a torque tube as the assembly is rotated. A second head is provided to make a similar weld at the opposite end

not circular but of a somewhat flattened but roughly elliptical shape, the head is arranged to move in and out (toward or away from the axis of rotation) as the weld is made. This motion is controlled by a cam that insures proper following of the contour of the cover.

After air clamping is done, the weld is made automatically by a $^{5}/_{32}$-in. electrode that is tilted at 45 deg to the plane of the weld, which is of the fillet type. Flux is fed and the unused portion is recovered after sifting, much as in other machines, being elevated to the supply hopper by mechanical means. As the housing swings through a circle of large diameter in an inclined plane, safety demands a guard to insure that the operator is in safe position. This guard is a bar joining two arms that have to be swung upward and must be fixed in an elevated position before the machine will cycle. After the welding is completed and the housing comes to rest, the guard is lowered to facilitate unloading and reloading.

Production of axle housings involves, in all, no less than twenty-one automatic submerged-arc welds of which four are the long longitudinal welds joining the two halves; two are circular, fastening flanges to the axle; one follows the contour of the rear cover; and the remainder are either arc shaped or straight and fasten the several brackets in place. Thus, the weldment is one of the most complex produced anywhere in so large a volume and with nearly all joints of automatic submerged-arc type. Although many machines are required, their output is high and welds are made rapidly, though they are uniform and of highest quality.

Torque Tube Flanges

Axle housings, however, are far from being the only chassis components that involve assembly by automatic submerged-arc welding. Some such components have long been similarly arc welded and continue to be. Among other new types of welding, the following examples are noteworthy:

Two new additional fixtures, like that in Fig. 7, produce the circular joints that fasten stamped flanges to ends of torque tubes. After the parts are placed in the fixtures, an air-operated plunger forces the flange hub over the tube end until it reaches a stop. Thereupon, the head rocks down and lowers the electrode, set at a 45-deg angle, until aimed at the corner in which the fillet weld is to be laid down.

Flux then starts to feed and, the moment that the electrode contacts the work, rotation starts and welding proceeds through a full revolution of the weldment plus a $^{1}/_{2}$-in. overlap. Before the overlap is made, however, a scraping tool, operated by a small air plunger is fed in automatically to remove flux fused on the portion of the weld to be overlapped.

As soon as the weld is completed, current is cut off, the head is automatically retracted and the weldment is unclamped, ready for unloading. This machine has a second head at the opposite end of the tube. Plans call for making a simultaneous weld to fasten the second end fitting. At present, however, this joint is made by

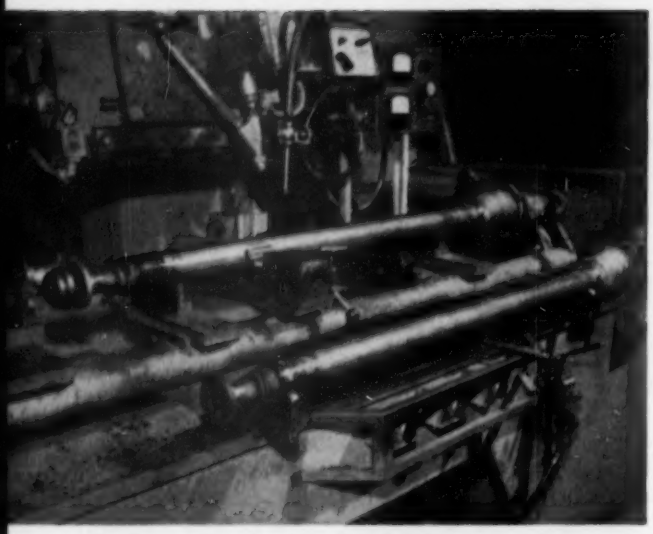


Fig. 8 In this machine, a bracket that anchors one end of a strut rod is fastened to the side wall of a torque tube along two edges of an angle-shaped bracket, the work being rocked between the two welds

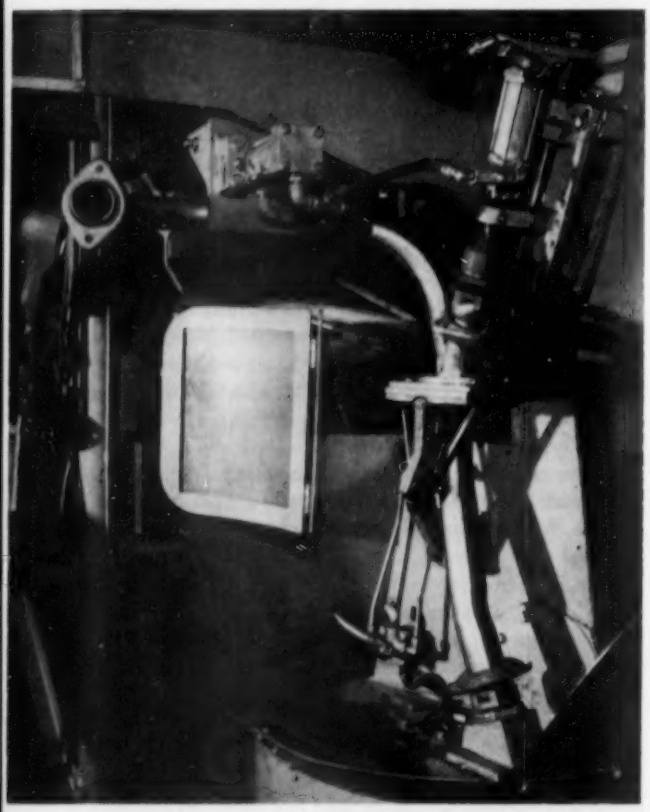


Fig. 9 Setup in a machine that joins branch exhaust pipes to a main pipe as the assembly is rotated about a vertical axis. Electrode wire and flux are fed through separate tubes that are nearly horizontal

flash welding in a machine long used for this purpose.

Figure 8 shows one of two other new machines not mentioned above. They weld brackets for anchoring strut rods onto torque tubes. This bracket is made from two angle-shaped stampings placed back to back. One of these brackets is welded near the center of each torque tube, which is $3^1/_2$ in. in diam. Angle legs that are not back to back are formed to an arc that fits the tube outer diameter. Arc welds have to be made along the straight outer edges of the angles parallel to the tube axis. Each machine has a fixture in which the tube and bracket are clamped, and a single automatic welding head whose $^5/_{32}$-in. electrode is rocked into position for the first fillet weld.

This weld is produced by traversing the head along one straight edge of the bracket. When the weld is completed, the head retracts automatically. The tube and fixture are then rocked through an angle so that, when the head is rocked back again, it is in position to make the second weld along the opposite edge of the bracket. When this is completed, the head is retracted and the weldment is unloaded.

Exhaust Pipes

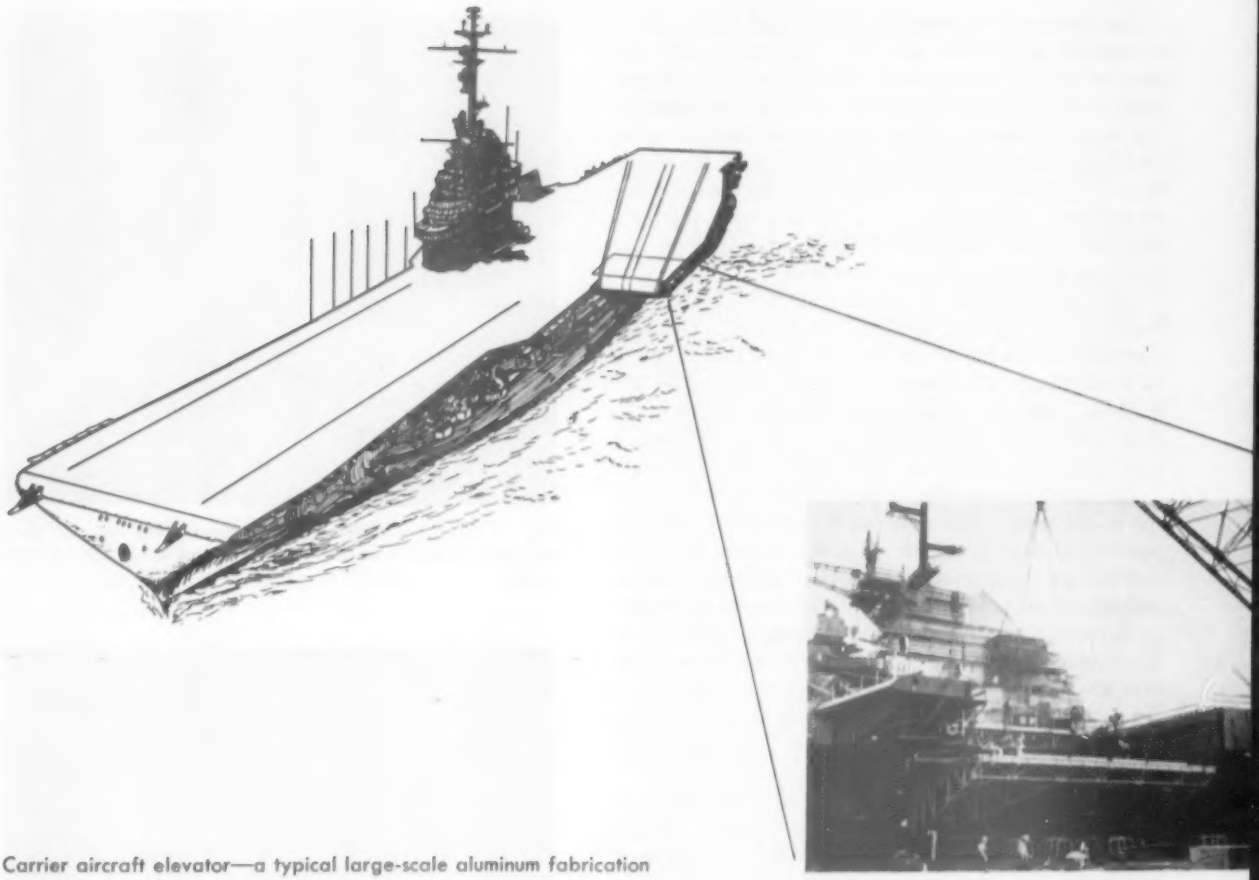
Changes in the design of the exhaust pipes for the V-8 engine has necessitated a change in welding where the two branch tubes join the main tube. Shapes and lengths of the tubes make handling somewhat awkward, but the ends to be joined are first cut off at the correct angle and one side of each is formed to a half circle. After the straight edges of the branch tubes have been placed together and clamped in a fixture, two hand arc welds are made to join the mating edges, as the joints do not lend themselves to automatic welding.

This weldment and its mating main pipe then are placed in the fixture of another special machine, as in Fig. 9. A 3 o'clock weld is made with $^5/_{32}$-in. wire fed through a long and nearly horizontal tube which is necessary since the head must be outside the main frame of the machine. Flux is fed through a parallel tube through which flux is moved by light air pressure.

This flux deposits on a ledge, as in most 3 o'clock welding, so as to keep the arc covered. As the weld is made, the workpieces being welded are rotated about a vertical axis but retain their relative positions. Support for the head is on a column outside the frame of the machine and the control panel is made movable so that it can be placed close to the operator working in a position where he can see the outer end of the flux tube.

Unfused flux falls on a screen and is elevated to a hopper at high level for reuse.

From the foregoing, it can be seen that automatic submerged-arc welders have become of increasing importance in automobile production. Their number is the largest ever used in the Buick plant and both the number of welds made and the number of different parts welded are much increased.



Carrier aircraft elevator—a typical large-scale aluminum fabrication

LARGE-SCALE ALUMINUM FABRICATIONS

Authors describe the fabrication procedure for an aircraft aluminum elevator to be installed on an aircraft carrier

BY S. I. ROBERTS AND O. P. CARDINAL

SYNOPSIS. The welding of an aluminum deck edge elevator for an aircraft carrier involves many details of successful metal joining. Many articles have been written about welding of aluminum in general and about the inert-gas-shielded arc-welding method in particular. Therefore, to avoid repetition this paper will treat only two aspects of the fabrication because they are believed to be fairly new, practical and of more than usual interest. They are:

1. Joint preparation: complete machining of the joints to obtain quality and economy.
2. Procedure: a practical, logical method of assembly that builds quality into the completed structure.

The Elevator

The temptation for using the lightweight aluminum for shipbuilding has interested the designer for years, yet the questionable and unknown factors of joining has retarded its use. However, with the advent of the present methods of welding with the inert-gas-shielded arc, its use has increased. A greater use can, no doubt, be expected in the future, especially in shipbuilding.

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The Navy air arm now has larger and faster planes to operate off aircraft carriers. The jet aircraft has required changes unforeseen when some of the present ships were designed. To satisfy this new requirement, the naval architect is being asked to redesign for more and larger aircraft facilities, thereby moving the center of gravity in an amount and direction he does not like to tolerate. Therefore, aluminum is a very desirable material to save one-third of the dead weight on any structure added above the water line.

Elevators are used to transfer aircraft between the hanger deck and the flight deck of carriers. The type discussed in this paper are the deck edge, either folding or nonfolding. The hinged is usually located on the starboard side and is made to fold against the side of the ship when in the stowed position. The other forms a part of the angled deck as shown in the lead illustration.

The problems of designing and building are similar for either type. The designer is confronted with the problem of calculating for a maximum load placed on any part of the elevator deck. The load requirements and the tensile strength of 618 T6 aluminum dictated a very complex pattern of tube and shape joints. These presented the designer with many strength behavior problems with too many "K" factors in calculating for the load. Yet, the reward of saving about 30,000 lb of dead weight while increasing the pay load nearly 10,000 lb was ever before him.

Figure 1 shows a typical intersecting joint which requires the highest type of design engineering. Also, it sent the production shops searching not only for good shipfitters, but for men particularly skilled in this type of fabrication. Since this elevator was built, our yard and other Navy yards have built similar types, some much larger. Service has proved the designer right and the production shops capable.

Planning

Some over-all careful planning was most essential before a structure of this size and shape could be built. The finished platform size is about 42 x 56 ft. The procurement of about 40 tons of material, tubes, plate, and extruded shapes, many not standard, was in itself new and rather unusual. Most of the tubes were from 3 to 8 in. OD and from $^1/_2$ to 1 in. wall thickness. In shop planning, a survey of the necessary facilities was in order. It was calculated that by keeping within close tolerances, the assembled unit would pass through the shop doors. The riggers determined that the cranes were adequate to move the structure outside, invert it and then return it into the shop. With this assurance, it was decided to take advantage of indoor shelter while building and to enjoy the benefits of inverted assembly. Also, the available inert-gas metal-arc welding equipment was carefully checked because more than 50 miles of 43S wire would be fed through these machines before the job would be done. Incidentally, before this was completed, an inventive welder made an angle tip for his welding gun so he could reach some of the inaccessible places to assure top quality welds.

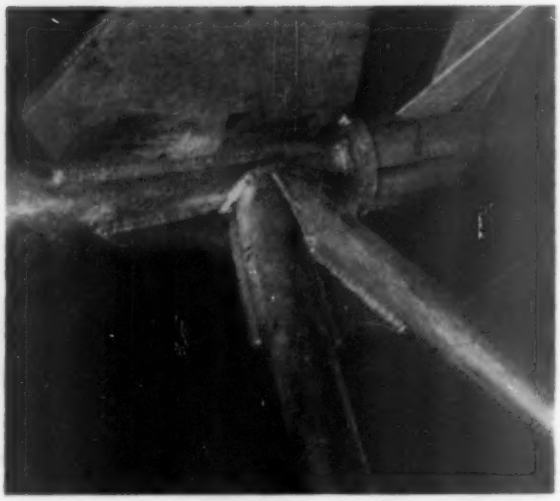


Fig. 1 View showing a typical gusset tube type of connection. The joint unwelded is joined last to reduce residual stress

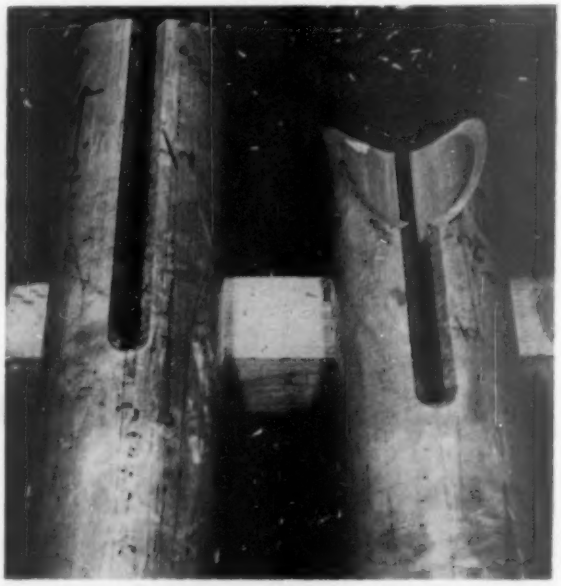


Fig. 2 View showing a typical machined joint preparation

Joint Preparation

Figure 2 shows the machined joints on two tubes with the slots for the gussets and on the tube ends. A glance at the complex intersections and the entire design reveals the desirability of a close fit-up on all joints. This machining, resulted in beneficial conditions at the junction of tube to tube or of tube to plate. When first proposed, this procedure sounded most attractive because of its contribution to weld quality and the resultant minimum loss of heat treatment in the base metal. At the same time, it was realized that it also resulted in a very favorable over-all cost picture. A careful estimate of the actual time saved

was nearly 1000 man-hours per elevator. This saving was made possible by the reduction in the layout time as well as in the handwork of finishing.

The slots for the gussets were machined to a 45-deg angle on a vertical milling machine. The joint was made to a point located on the tube by the fitter or to two points, as some of the slots did not open on the end of the tube. A total of all identical or similar machine jobs were grouped together for one setup to further reduce the unit cost.

At the assembly, the gussets fitted neatly into the slots, making an ideal weld joint preparation. Figure 1 shows why this was so important. A well-fitted joint is very necessary to obtain better inert-gas behavior, especially when welding from only one side.

The ends of the tubes were machined with a shell mill or a fly-cutter. Thus, the angle as well as the shape could be cut without the detail of a layout or of "loft" time. The tube ends fit closely, whether joining to a flat or to a tube. Fit-up is all important in a complex structure such as shown in Fig. 1.

Procedure

A procedure should spell out many details of fabrication; however, as used here, it is more of a sequence of erection and welding. It is quite apparent that close cooperation between fitters and welders will aid in producing a quality product.

Figure 3, is a sketch of a folding or hinge-type elevator built for the No. 3 deck edge position. Here, the supporting structure is shown in an inverted position. While this is not the only position in which the parts can be assembled, it does offer some definite advantages. It was believed that the quality of the welds would be better if the accessibility and weld position were improved. Some of the welds were made after the structure was turned over to the operating position. However, the real advantage lies in the erection and welding sequence. This method allowed full advantage to be made of the prefabrication of the eight truss sections.

The parts identified in Fig. 3 can be used to illustrate a basic sequence. The truss sections were assembled in a jig using a logical order as follows (keeping in mind that the top and bottom refer to the inverted position shown):

1. Weld the gussets into position and secure the top cord "E" (tubes) and the bottom cord "B" (I-beam).
2. Attach the vertical and diagonal tubes "C" to the top cord.
3. Lower the top cord "E" with the vertical and diagonal tubes "C" into position. By this method, all the tube slots slide over the gussets with a minimum of clearance and tolerance.
4. At the midway point on the longest section of the top cord "E" ,the tube size changes from 8 to 6 in. OD. This was left unwelded serving as an expansion joint until all the welding on the truss was completed. This left a minimum of residual stress in the completed section.

Figure 3 also shows the truss sections assembled to form the supporting structure. Here again, the position is good for a logical assembly and welding sequence outlined as follows:

1. The longitudinal I-beams "X" were positioned on the shop floor, and secured in place with the proper longitudinal and transverse camber.
2. The center truss was positioned in place. The adjacent trusses were moved into position using the technique of joining the longitudinal tubes "Z" into the gussets as used on vertical tubes. This allows welding toward a free end.
3. The final weld of the supporting structure was made on the diagonal tubes "W" at the expansion joint "Y".

The structure was then inverted to the operational position and completed.

The plate for the deck is $^{3}/_{16}$-in. thick aluminum. These were prefabricated in six sections approximately 24 x 20 ft. in size. These were welded to the longitudinal I-beams with the full automatic process using the beam as a backing. The plate was welded on the underside to the I-beam flange with a continuous fillet weld.

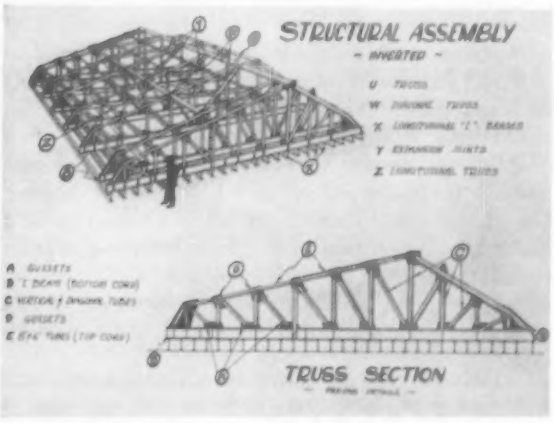


Fig. 3 A sketch of the structure to illustrate procedure

Quality Control

The welders were all qualified for the inert-gas-shielded metal-arc process, welding on plates in the vertical and in the overhead positions. Evaluation was made by visual examination and checked by radiography to Navy standards.

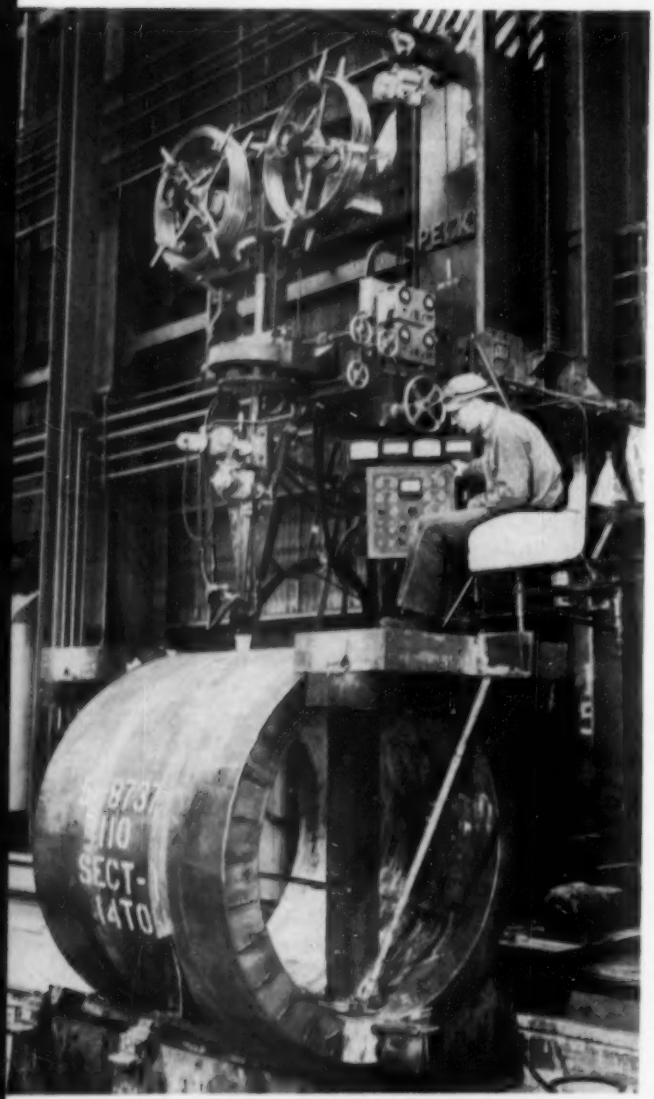
Where the geometry permitted, all finished production welds were radiographed with an X-ray machine.

The authors wish to express their appreciation to J. P. Bickinella of the Shop Superintendent's Office for his general assistance; to Robert M. Souza for his guidance and advice with the photographs; and to Andrew D. Abbott, Supervisor in the Shipfitting shops, for his cooperation and suggestions.

MULTIPOWER SUBMERGED-ARC WELDING OF PRESSURE VESSELS AND PIPE

Scott connection described by authors as providing simplest apparatus and control system for multiphase welding while retaining most advantages of the three-phase method

BY R. A. KUBLI AND H. I. SHRUBSALL



Multipower welding for longitudinal seam of 6-in thick wall pressure vessel

Introduction

Multipower submerged-arc welding has been known for at least ten years. It was largely developed in pipe-mill applications on carbon steel, where high rates of speed are required for the economical fabrication of pipe from plate stock. Multipower welding had its beginning when attempts were made to use single-wire welding setups in combination with each other. This work led to the development of multiphase power supplies such as the three-phase closed-delta system which employs two separately energized welding wires. More recently, attention has come to be focused on Scott-connected transformers for multiphase welding.

Multiple single-phase welding wires energized by combinations of a-c and d-c power and the three-phase closed-delta system were extensively used. These welding systems are still in use and giving satisfactory service on many installations. It is, therefore, apparent that multipower welding is not new in pipe-mill applications. However, the use of the simpler and equally effective Scott-connected system, first proposed in 1950, is growing rapidly.

Application of the multipower principle to pressure vessel fabrication has not been widespread. However, the urge for faster fabricating techniques is impressing pressure vessel fabricators with the advantages of multipower welding since little has been accomplished in recent years to increase speeds of single-wire welding on heavy plate. The equipment requirements of the closed-delta multiphase systems has deterred their adoption in pressure vessel work. The Scott system permits simplification of power equipment needed. Use of this system also simplifies the operation of a multiphase installation to the point where an average operator, qualified to use single-wire equipment on vessel work, can readily handle the operation of two individual welding heads employed in multipower welding.

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Presented at 1956 AWS National Spring Meeting in Buffalo, N. Y., May 7 to 11.

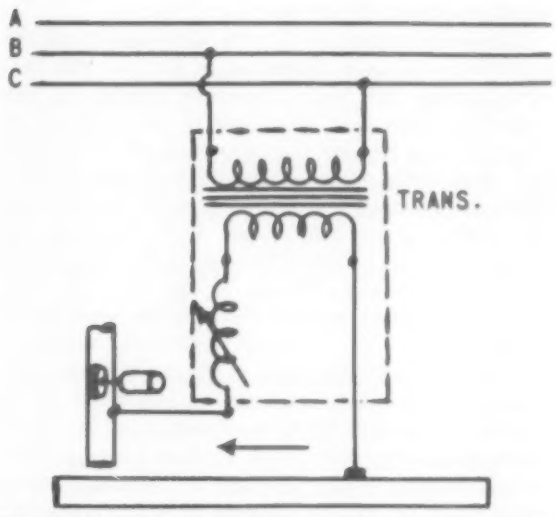

Fig. 1 Welding with single wire and a-c power supply (arrow shows direction of welding)

Both the Scott-connected and closed-delta welding systems provide high welding speeds (up to three times the speed obtainable with a single wire) with excellent control of weld shape and penetration. In multipass welding on pressure vessels where individual passes $^1/_4$ in. thick are sometimes desired, metal disposition rates have been limited. With multipower welding, the pass thickness can be maintained at $^1/_4$ in. or at any other desired dimension; and sound, well-shaped deposits can be made at high current and travel speeds.

This paper is primarily concerned with the three-phase closed-delta system because of its presently wider application and with the Scott system which is usually preferred to the closed-delta system on new installations.

What Is Multipower Welding?

Multipower welding employs two or more welding wires, generally arranged in tandem, and more than one power supply. The simplest form of multipower welding utilizes two welding wires connected to individual power supplies and placed together so as to operate in a single puddle. This system of welding evolved when it became evident that two wires provided a means of controlling or varying power distribution. Together, they permitted the use of greater total welding currents than could have been used satisfactorily on a single wire.

The result of using greater total currents was, of course, to increase the weld-metal disposition rate and, hence, permit greater welding speeds. The evolution from single-wire welding can be illustrated as shown in Figs. 1, 2 and 3. A basic circuit of a single wire connected to an a-c power supply is shown in Fig. 1. It is obvious that the welding wire and weldment are simply connected across the secondary of a transformer. A similar arrangement of a single wire connected to a d-c power supply is shown in Fig. 2.

The systems shown in Figs. 1 and 2 can be combined

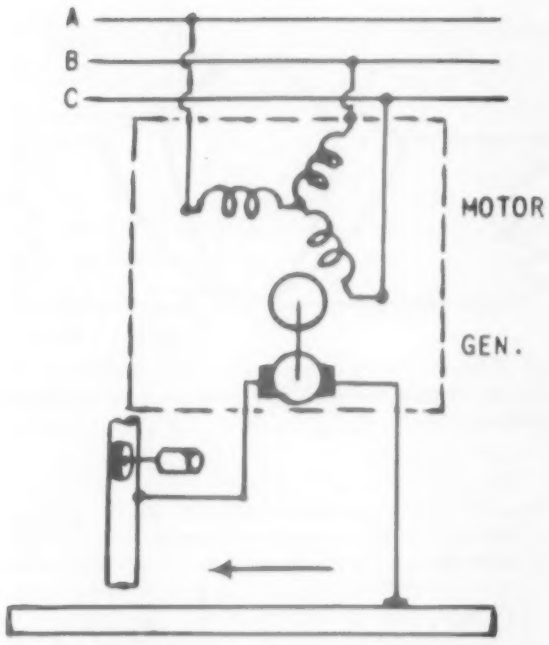

Fig. 2 Welding with single wire and d-c power supply (arrow shows direction of welding)

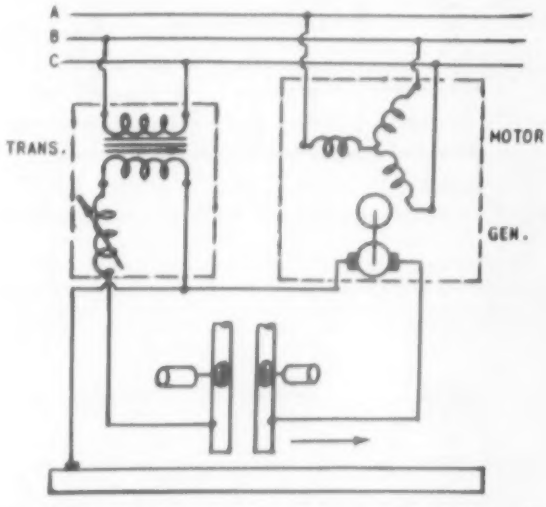

Fig. 3 Combination of d-c, a-c power supplies for multipower welding (arrow shows direction of welding)

as shown in Fig. 3. While possible to connect separate power supplies in several combinations other than shown in Fig. 3, the d-c, a-c system (dc on the lead wire and ac on the trail wire) provided the first means of markedly improving welding speeds over single-wire welding. In some instances, the a-c, d-c system has also been used. However, neither the d-c, d-c nor a-c, a-c identical phase combination provides the increased performance desired, because they are susceptible to magnetic arc disturbances which cannot be controlled. Magnetic disturbances are generally encountered when

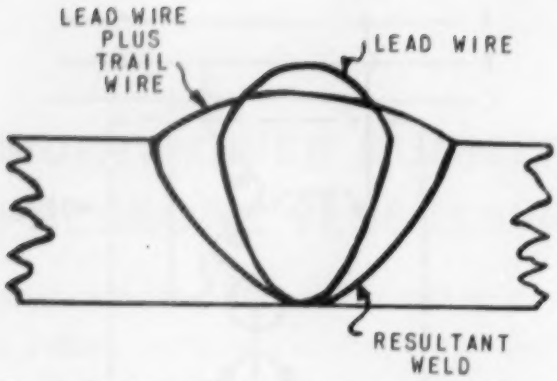

Fig. 4 Function of lead and trail wires in multipower welding

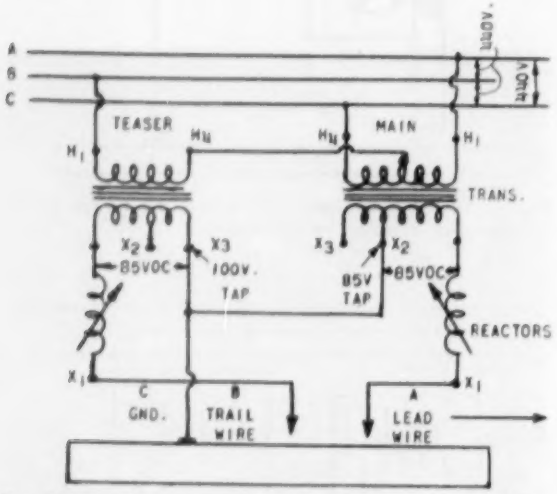

Fig. 5 Transformer connections for Scott-tandem welding

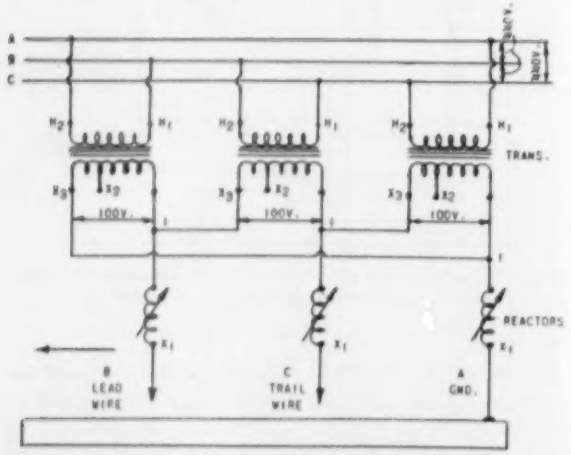

Fig. 6 Transformer connections for three-phase closed-delta welding

welding in deep grooves or inside tubular sections and may result from the presence of magnetic masses associated with jigging. Magnetic disturbances, or arc blow, have continually plagued the welding industry. External corrective methods are difficult to apply and are usually only partially successful.

The basic function of the two wires used in all the multiwire systems is illustrated in Fig. 4. The lead wire provides the desired depth of penetration and deposits a little more than half of the weld metal. The trail wire supplies the balance of the weld metal and controls the shape of the finished weld surface. While the illustration would seem to show that these two actions occur individually, the action actually occurs in a single puddle. The resultant weld forms as shown without any evidence of the two individual actions ever having occurred except in the crater at the finish.

Consideration of the action of the arcs obtained with multiple wires, each connected to individual power supplies, eventually led to development of the three-phase and Scott-connected two-phase systems. The use of two wires resulted in improved control of power distribution. In addition, the use of multiphase power supplies provided a control of arc deflection not possible with individual power supplies.

Control of arc deflection provides a means of shaping the weld and allows still greater welding speeds to be obtained. In single wire or multi-wire welding, a speed is reached beyond which peaking or undercutting of the weld occurs regardless of how the welding variables are adjusted. Investigation of multiphase systems revealed that adjustment of the welding variables can be made to deflect the trailing arc in a forward direction. Forward arc deflection eliminates undercutting and improves bead shape at speeds up to $2^1/_2$ to 3 times those usable with a single wire.

Multiphase Welding Connections

Scott-Connected System

The basic circuit of the Scott connection is shown in Fig. 5. It can be seen that two transformers are required and that one of the two transformers must have a center-tapped primary to make the "T" connection. The primary of the tapped, or main transformer, is connected across two legs of the three-phase line. The primary of the teaser transformer is connected to the center tap of the main transformer and the third leg of the three-phase line. Secondary connections to the welding wires are preferably made to the 85-volt tap on the main transformer and to the 100-volt tap on the teaser transformer. These preferred connections provide approximately 85 volts on each leg and help to balance the line loads. Weld results will not be adversely affected if transformers with tapped secondaries are not available. The teaser transformer can be used up to its normal rating. The main transformer can be used up to 85% rating, since its primary connections will be carrying approximately 15% more current than in normal use due to the teaser current. If the main transformer has a 100-volt tap which is not being used, it can be used up to its full rating. The preferred phase rotation at the welding zone is lead, trail, ground—or normal clockwise rotation.

A particular advantage of the Scott connection is that practically any commercial transformers can be used, as long as one has a center-tapped primary. The transformers need not have the same characteristics or current rating. From the viewpoint of operators, the Scott system is the easiest multiphase welding system to control. Only two welding controls are needed and there is no ground current adjustment. Arc voltage and current settings on each wire are essentially independent. Adjusting one does not require drastic readjustment in the other.

Three-Phase Closed-Delta System

The three-phase closed-delta circuit is shown in Fig. 6. All these transformers should have equal open-circuit voltages and have separable reactors which are placed in each leg for current control. The secondaries are connected in closed delta ahead of the reactor windings. The three leads of the delta connection are then brought to the two welding electrodes and ground as shown. Proper phasing, giving a rotation of lead-trail-ground, is also preferred in the closed-delta welding system. A phase meter should be used to check the phase rotation. Rated currents may be drawn from the transformers. The delta system provides individual control of the lead, trail and ground currents. These adjustments, however, are mutually dependent. If one is changed, the other two will also vary. Therefore, numerous adjustments of all these currents are required. Currents are chosen so that a phase angle between approximately 80 and 110 deg exists between the currents in the lead and trail wires, which experimentally has been found to give best welding results. However, this phase angle may be adjusted between limits as wide as 60–140 deg if particular circumstances warrant.

Multipower Welding Variables

Weld quality produced by the multiphase systems is affected by several variable factors. Among these are power distribution, the phase angle between the welding currents, phase rotation and arc voltages. A discussion of these variables follows.

Welding Power Distribution

In practice, it has been generally found desirable to have the trail welding wire carry less current than the lead wire. The trail current is on the order of approximately 85% of the lead wire current. At slow welding speeds, changing the ratio between the two currents will not have a marked effect on weld quality and considerable variation can be tolerated without ill effects.

In the Scott connection shown, it is impossible to separately adjust the ground current. The ground current is higher than either the lead or trail currents; its magnitude depends on the values of the lead and trail currents. The ground current may be approximated by taking 1.4 times the average of the lead and trail currents. Typical welding conditions using the Scott-connected system for two-pass welds in $^{5}/_{16}$-in. thick line pipe employ 925 amp and 30 volts on the lead wire and 825 amp and 39 volts on the trail wire. The ground current under these conditions would be approximately 1220 amp.

With the closed-delta system, the value of the ground current can be adjusted as well as the welding currents. It is usually adjusted to be slightly higher than either one of the two welding currents.

Arc Deflection and the Significance of Angles Between the Current Phases

As previously discussed, forward deflection of the trail arc has been demonstrated to be beneficial for obtaining smooth weld surfaces at high speeds. The actual mechanism of arc deflection is somewhat complex and depends on the ratio of the lead and trail currents, phase rotation, and the angle between the phase of the two welding currents. For convenience in further discussion, the angle between the phases is called the phase angle.

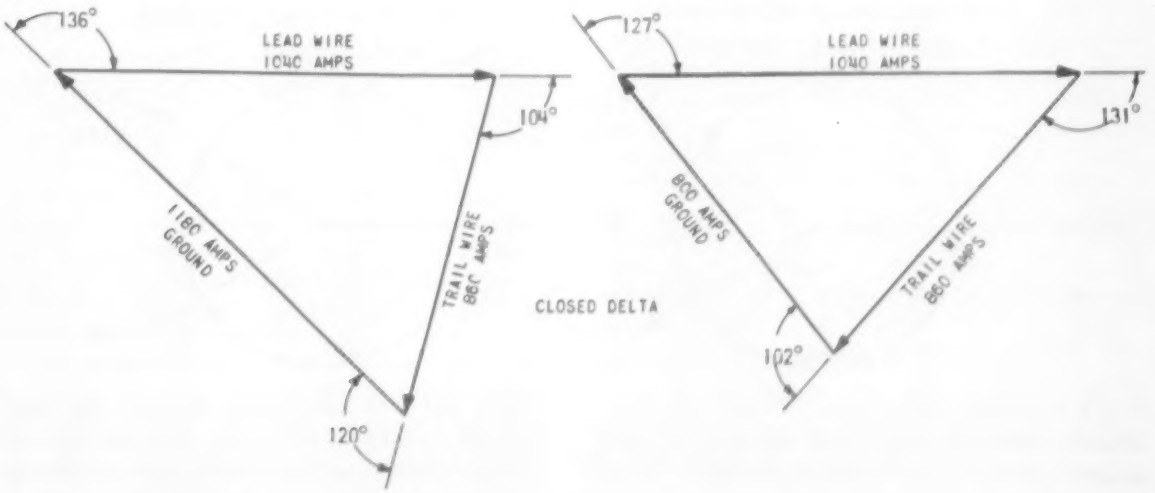

Fig. 7 Welding current and phase angle relationships for closed-delta system

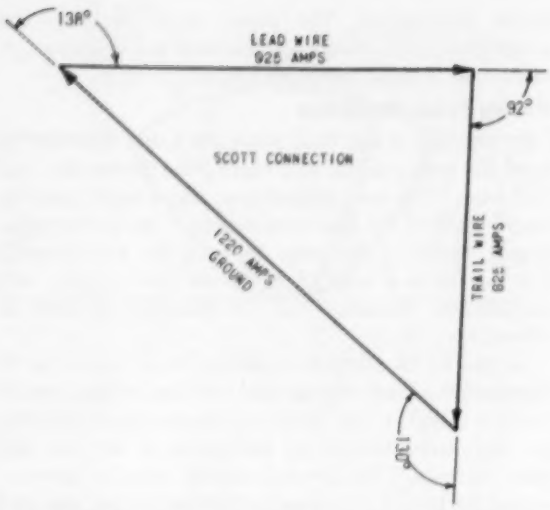

Fig. 8 Welding current and phase angle relationships for Scott-connected system

By using either the multiphase Scott or closed-delta connections, it is possible to exercise control over arc deflection. It has been found that by varying the welding currents of the lead and trail welding wires, and the ground current in the case of the closed-delta connection, the magnetic fields produced can be used to deflect the arc of the trail wire in a forward direction. With the Scott system, a similar result is obtained by adjustment of the lead and trail currents alone.

Deflection of the leading arc is relatively unimportant since the trail wire controls the final surface appearance of the weld deposit. The phase angle is determined by the amount of welding current applied to the lead and trail wires, as well as the current on the ground connection. With the Scott-connected system, where the ground current is in a fixed relationship with the two welding currents, very little control of the phase angle between the two welding currents is obtained. With the closed-delta system which provides adjustment of the ground current, a wide range of phase angles can be obtained.

The current relationship at the arc can be illustrated by representing the lead, trail and ground currents vectorially and arranging them to form to form a closed triangle. Typical current relationships for the closed-delta system are shown in Fig. 7. It can be seen that with control of the ground current, the phase angle between the lead and trail currents can be altered. Similar current relationships for the Scott connection are shown in Fig. 8.

Some control over the phase angle can be obtained by varying the lead and trail currents. It is obvious, however, that the more-or-less fixed ground current prohibits any large changes. The phase angle relationship between the welding currents regulates the time periods during which the two welding wires are of similar or dissimilar polarities. The polarities of the welding wires and that of the ground determine whether the trial arc is deflected forward or backward.

Phase Rotation

Another important factor also controls weld quality at high welding speeds. This is phase rotation or phase sequence. Experience shows that a phase rotation of lead, trail and ground currents is necessary when using either the Scott or closed-delta systems. At slow welding speeds, the effect of a reversed phase rotation of lead, ground and trail currents will be less apparent on weld quality. At high welding speeds, improper phase rotation will result in poorly formed welds.

Phase rotation has a bearing on arc deflection because it also regulates the time-polarity relationship of the welding currents. The phase angle is affected by phase rotation. For instance, with a normal phase rotation of lead, trail and ground as shown in Fig. 9, a given set of lead, trail and ground currents might produce a

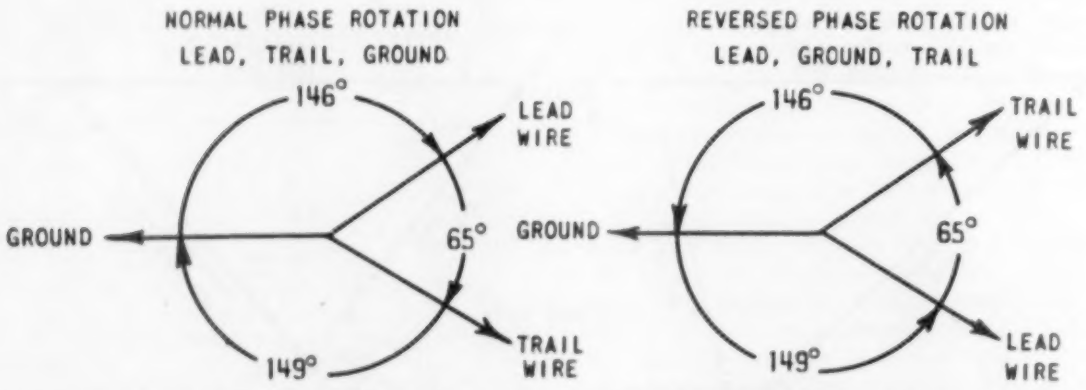

Fig. 9 Effect of phase rotation

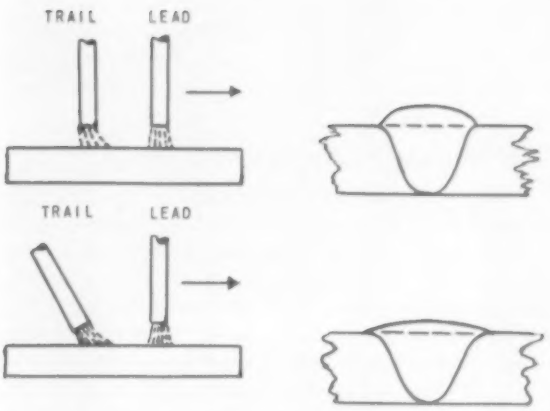

Fig. 10 Effect of wire orientation (arrow shows direction of welding)

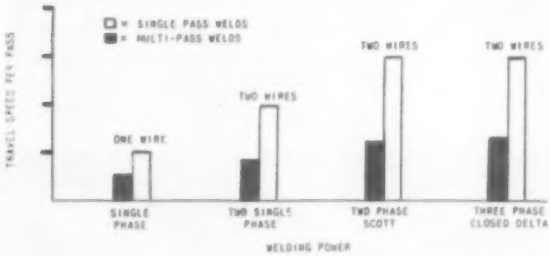

Fig. 11 Comparison of single-wire and multipower welding systems

phase angle of 65 deg. If the phase rotation is reversed —for example, by interchanging welding leads at the busbar—the phase angle will be changed from 65 to 295 deg as illustrated in Fig. 9. In other words, the altered phase rotation has set up an entirely different time-polarity relationship between the two welding currents and the ground current. (Note that in the normal phase rotation, a current sequence of lead, trail and ground is set up. With reverse phase rotation, a current sequence of lead, ground and trail exists.)

Wire Size, Spacing and Orientation

Wire orientation can also be used to control arc deflection by arranging both wires or the trail wire alone so that a slight "ploughing" effect is achieved. As illustrated in Fig. 10, such configuration also tends to blow the arc forward.

Wire sizes of $^1/_8$, $^5/_{32}$ and $^3/_{16}$ in. are most commonly used in multipower welding. The larger sizes have come into general use because of the current requirements for welding the heavy materials involved. Multipower welding has generally been applied to materials over $^3/_{16}$ in. thick.

Wire spacing is an important but not critical factor, as long as the trail wire enters the puddle before solidification begins to occur. Wire spacing is a variable which affects the magnetic interaction of the fields around each wire. Spacings established by experience vary from approximately $^3/_4$ to $1^1/_4$ in.

Fig. 12 Machine for multipower welding

when the welding currents on each wire are on the order of 900 amp.

In some instances, it has been found beneficial to operate with dissimilar size welding wires. For example, a $^1/_8$-in. wire would be used on the lead wire and a $^5/_{32}$-in. wire would be used on the trailing wire. This combination provided a speed increase of 10% on one installation.

Welding Speeds

Figure 11 illustrates the relative welding speeds attainable with single and various multiwire welding systems. The chart is idealized and is intended to show the speed ranges that may be employed commercially for single and two-pass welds in pipe work and for multipass welds in the pressure vessel industry. The chart shows the remarkable speed increases attained with multiwire welding as compared to single-wire welding. These increases are most noticeable for single-pass applications. While multipass procedures have also been greatly speeded up, they have not yet reached the lineal speeds of single-pass work. As shown in Fig. 11, multiphase systems provide the highest welding speeds although their potential has not yet been fully realized. The identical power supply multiwire systems fall in between the single-wire and multiphase systems as shown.

Equipment for Multipower Welding

Multipower welding equipment is usually custom-assembled for a particular application by combining standard welding heads. On vessel work, the installation is usually integrated with a welding fixture or travel carriage. One machine, shown in Fig. 12, is

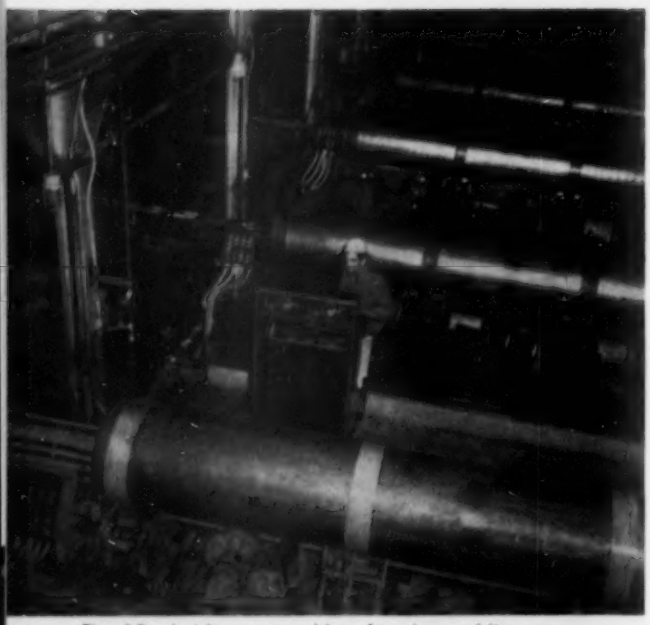

Fig. 13 Inside-seam welders for pipe welding

available as a portable unit for multipower welding. The basic elements of such a machine are two separate heads, two controls, and a nozzle for directing the welding wires. The wires are insulated from each other.

Application of Multiphase Welding

Multiphase welding has been found to be applicable primarily to heavy weldments such as found in pipe mills, in pressure vessel manufacture, and for joining ship plate. Figure 13 shows a bank of inside-seam welders at Consolidated Western Steel Division at the Geneva, Utah, mill of the United States Steel Corp. Here the longitudinal inside welds are made at approximately 80 ipm first, using Scott-connected transformers with copper backing. The longitudinal outside welds are then made as shown in Fig. 14 with the same technique and at similar speeds. All welds are made with traveling welding heads. Another practice for welding the outside seams consisted of pushing pipe to be welded past stationary welding heads. The welded pipe is hydraulically expanded up to approximately $^1/_2$ in.

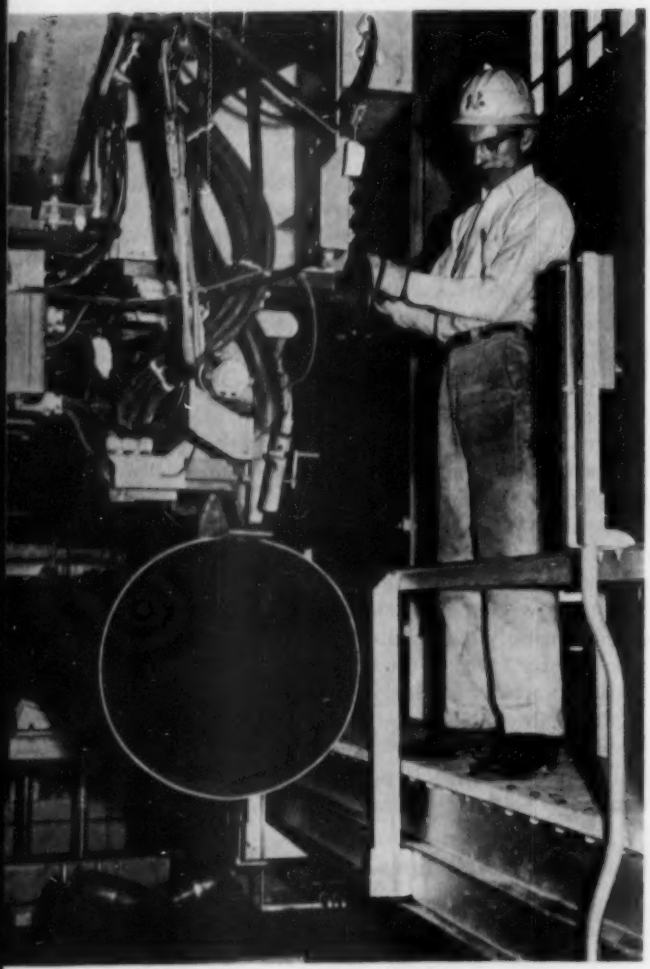

Fig. 14 Outside-seam welders for pipe welding

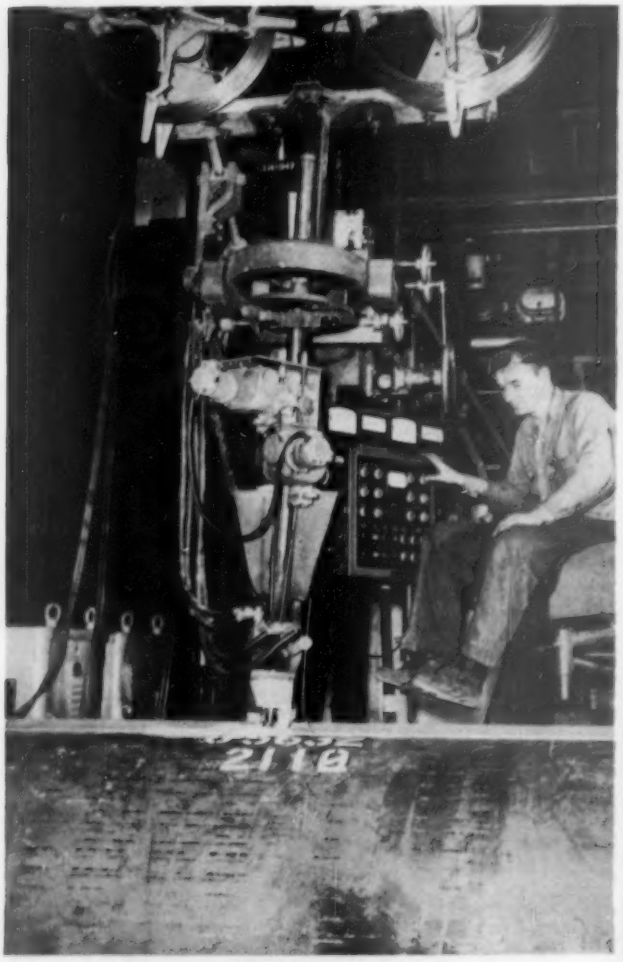

Fig. 15 Multipower welding for longitudinal seam of a pressure vessel with two all thicknesses

Fig. 16 Multipower welding for circular weld

on the diameter to round it out and to increase its yield strength.

Figure 15 shows the welding of the longitudinal seam in a vessel at the Foster Wheeler Corp., Mountaintop, Pa., using Scott multipower welding. As shown, this vessel has one heavy and one medium wall thickness. The lead photograph shows a similar seam being fabricated in a vessel with a wall thickness of approximately 6 in. These joints are multipass welded, and welding conditions are varied as the weld progresses toward the top of the groove. Approximately five single-wire passes are put in the bottom of the groove using a welding current of 450–600 amp, a travel speed of 10–14 ipm, and $^5/_{32}$-in. diam wire. The Scott-tandem passes are then put in at approximately 600 amp, 32-volts lead, and 500-amp, 34-volts trail at 18 ipm. After approximately ten passes have been deposited, the welding currents are changed to 750-amp lead, 600-amp trail, and the welding speed increased to 20–22 ipm. After the weld comes further up in the groove, the currents are increased again to approximately 950-amp lead, 800-amp trail; the welding speed is raised to 28 ipm. Approximately 20 passes are used in a 2-in. joint. The single-wire passes are made with the same equipment operating with only one wire. The tandem welding is done using two $^5/_{32}$-in. wires spaced approximately $1^1/_4$ in. apart.

The circular weld shown in Fig. 16 is made in three passes at 20–25 ipm using currents on the order of 700 (lead) and 600 (trail) amp. The very same equipment shown in Figs. 13–15 is used. As previously indicated, this equipment utilizes Scott-connected transformers to facilitate the control of welding variables. Use of the Scott connection is particularly advantageous where necessary to apply this equipment to many different welds or when necessary to alter the welding current and voltage during multipass welding.

Conclusion

Submerged-arc welding with multiphase power is now a noticeable trend in the pipe and pressure vessel industries. The advantages of high-welding speeds and high deposition rates make this technique attractive where larger amounts of repetitive welding are involved.

The Scott connection provides the simplest apparatus and control system for multiphase welding while retaining most advantages of the three-phase method.

Acknowledgment

The authors wish to express their appreciation to the Consolidated Western Steel Division of the United States Steel Corp. and to the Foster Wheeler Corp. for the illustrations and data which each organization has made available.

ON-THE-SPOT WELDING COMPLETES "MAID OF THE THE MIST"

BY R. H. SLEMIN

Since 1885 tourists and honeymooners have been thrilled by a boat ride on tossing waters to the thundering 162-ft Niagara Falls in the "Maid of the Mist." So, when fire put the two boats that operated between the Canadian shore and the Falls out of commission, cruel disappointment faced sightseers.

To Russel-Hipwell Engines Limited, of Owen Sound, Ontario, fell the task of designing and building a new "Maid of the Mist" (see Fig. 1) in record time.

Safety was a large factor in the construction of the new boat, for passengers must be carried through changing water levels, rocky shoals and swirling currents.

To give the new "Maid of the Mist" necessary sturdiness and strength, a boat of all-welded steel construction, 66 feet long with a molded beam of 16 feet and powered by twin turbo-diesels, was decided best.

Prebuilt sections of the ship were taken 180 miles from Owen Sound by truck and then down the road to the floor of the Gorge for assembling (see Figs. 2

R. H. Slemin is associated with Air Reduction Canada, Ltd., Toronto, Ontario.

Fig. 1 New "Maid of the Mist" with a load of passengers against the awesome sight of Niagara Falls

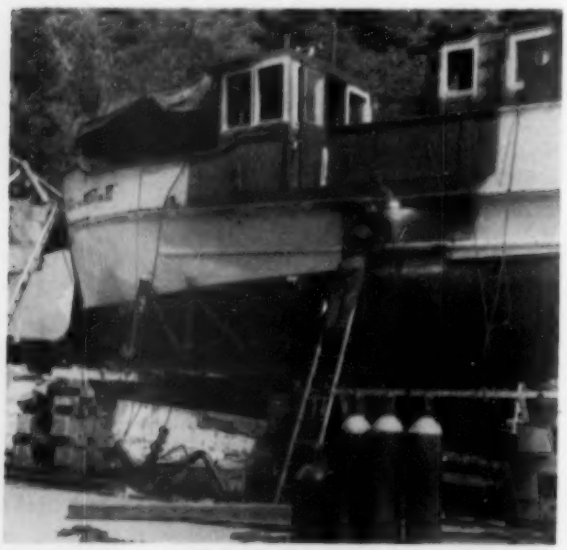

Fig. 2 With the superstructure in position, the last welds are made in the seams of the new "Maid of the Mist"

Fig. 3 Half of ship in position on blocks. Engines were welded in the hull before delivery to final assembly point at Falls

Fig. 4 Fitting the halves of the stern section together. On-the-spot welding operations provide sturdy seams

through 4). This delivery, section by section, was necessary because of steep terrain to the water's edge.

The total building time was only 6 weeks and involved the use of 1550 lb of $^3/_{16}$ in. diameter arc-welding electrodes. Welds were made in all positions in both $^5/_{16}$- and $^3/_8$-in. mild-steel plate.

As a result of the efforts of all parties concerned, the new "Maid of the Mist" was completed in twelve weeks.

This new diesel-driven "Maid of the Mist No. 3" replaces her 19th Century steamer sisters in almost everything but the route. She still operates around the original route beneath the very foot of both the Canadian and American Falls.

Now the new boat is in service, providing thousands of delighted and amazed people from all over the world with its famous trip—giving them unforgettable pictures of the Falls and Rainbow Bridge.

STEEL BRIDGES TO THE WEST

BY T. H. NICHOLL

Corn may be conventionally as high as an elephant's eye in Kansas, but not as high as the arc welder shown in Fig. 1 while making a field splice in one of the 4-ft-deep girders taking a secondary highway over the Whitewater River near August, Kan. Since 1936, highway engineers in the cornflower state have been making extensive use of arc welding in shop and field for new bridge jobs, and much of what has been learned since that time has been helpful in laying out the designs of the 256 bridges on the budding 236-mile Kansas turnpike which ranges from Kansas City westward and southward through Lawrence, Topeka, Emporia, Wichita, Wellington and on to the Oklahoma border.

Intermediate stiffners, shown here skip welded to the girder webs, are left off the outer girder web faces, which serves not only to save weight, but also to enhance appearance in the minds of esthetic Kansas bridge engineers.

In his precarious position (Fig. 1) the welder is completing the field splice on the 1-in. top girder flange, the bottom flange splice having been completed and the web weld partially run. Note the 1-in. outward projections at the ends of the top flange, presumably to give added strength to this welded juncture, although probably not entirely necessary. Girder sections are, of course, shop prefabricated and require only field splicing, minimizing the amount of out-of-position welding necessary.

The pattern set by some of the smaller welded bridges in Kansas fitted nicely into the turnpike construction where an outlay of $23 million was involved for bridges alone, figuring to better than one bridge per mile of road. The new two-lane pike calls for an investment of $160 million, derived from revenue bonds, aimed to be amortized over 19 years through tolls.

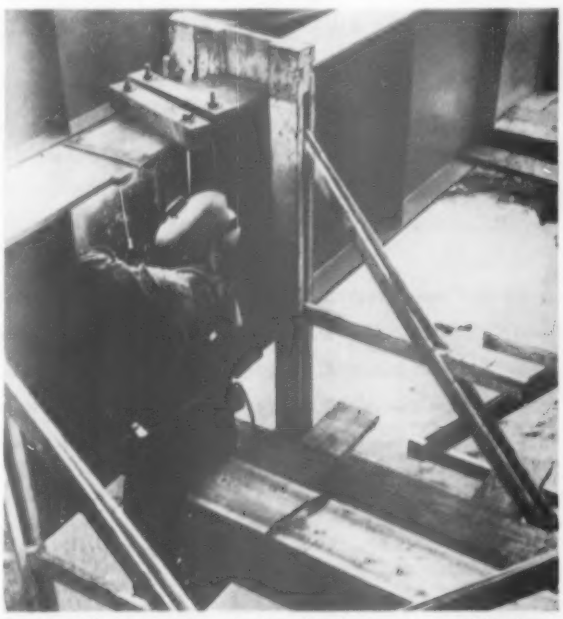

Fig. 1 Welder making field splice in one of the 4-ft-deep girders taking a secondary highway over the Whitewater River near August, Kans.

T. H. Nicholl is District Engineer, The Lincoln Electric Co., Cleveland, Ohio.

Society News

Educational Activities Committee Formed

The AMERICAN WELDING SOCIETY, recognizing its duty to its membership, has reactivated its effort in the field of education. A special Committee of the National Board has studied the field of educational activities during the past year.

In line with the action of the Technical Council, a new committee called the Educational Activities Committee has been formed. This Committee shall deal in subjects having to do with the education of personnel engaged in and associated with welding.

In accordance with this action and in conformance with the statement of the objectives of the AMERICAN WELDING SOCIETY, the work of the Educational Activities Committee may be stated as follows: to improve the education and usefulness of personnel engaged in and associated with welding.

It is understood that the EAC is an action group with advisory and coordinating duties similar to those of the Technical Activities Committee which operates in the technical field.

In order to carry out this task, the activities are being organized in the following fields:

1. Educational courses
2. In-plant training
3. Extension training
4. College training
5. Trade school and apprentice training
6. Visual aids
7. Technical institute training

Members of the AWS are being actively recruited for tasks in the various fields. It is felt that the educational facilities dealing with welding are of primary importance and only through proper education can the full application of welding result.

AWS DIRECTORS-AT-LARGE

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Congratulations, Miss O'Leary!

In October, Miss O'Leary, you completed thirty years of continuous association with The Welding Journal, and we—your fellow workers on the Editorial Staff, your associates at AWS headquarters, and your many other friends among our Society's members—take this opportunity to extend to you our sincerest congratulations for such a magnificent record.

Your unbounded devotion to the Journal throughout these many years has contributed much to its success. Thanks .....and very best wishes for the future!

Enroll as Supporting Companies

Three more companies have recently enrolled as supporting company members. They are as follows:

Delta Tank Manufacturing Co., Inc.
Choctaw Road
Baton Rouge, La.

Esso Standard Oil Co.
P.O. Box 551
Baton Rouge 1, La.

Nichols Construction Co., Inc.
P.O. Box 2310
Baton Rouge, La.

These memberships became effective n Oct. 1, 1956.

USCG Yard Becomes Sustaining Member

U. S. Coast Guard YARD, Curtis Bay, Md., has enrolled as a sustaining member of the AMERICAN WELDING SOCIETY.

The activities of the YARD include shipbuilding, boat building, ship repair and alterations, general fabrication and manufacturing of mechanical, electrical, electronic equipment and plastic boat building for the U. S. Coast Guard and Army, Navy and Air Force.

Lt. Cdr. R. S. Capp has been appointed sustaining member representative.

EMPLOYMENT SERVICE BULLETIN

Positions Vacant

Need engineers or physicists experienced with liquid oxygen application and use, design of gaseous or liquid regulators helpful, also designers of storage containers of liquefied gases. Modern plant located in beautiful Mississippi river city. Salaries $6000 per year up, depending on experience. Employer pays fee, interview and relocation expense. Send detailed résumés in confidence to: H. E. Riordon, Chenhall Employment Service, Davenport, Iowa.

V-337. Excellent opportunity for editorial assistant-space salesman. National engineering society monthly requires resourceful, capable assistant to sell advertising space and to aid with over-all editorial and production activities. Field closely allied to metallurgy and metal fabrication. In reply please outline experience and personal history.

V-338. Welding engineer. Excellent position open for a welding engineer who will be responsible for routing, control and inspection of welded and fabricated copper-base materials. Prefer a mechanical or chemical engineer with some experience in the field of welding or fabrication of pressure vessels. Excellent starting salary and company benefits. Write stating experience, education and salary expected in first letter. All replies will be regarded as strictly confidential.

Mechanical engineer. K-G Welding Equipment Division offers an unusual opportunity to an experienced design and development engineer on gas welding and cutting apparatus. If you are stymied and are ready to take a position of senior responsibility with an alert growing organization, send your qualifications in confidence to B. H. Van Dyke, Air Products, Inc., P.O. Box 538, Allentown, Pa.

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Section News and Events

as reported to Catherine O'Leary

New American Welding Society Section Organized in Baton Rouge

A new section of the AMERICAN WELDING SOCIETY has been organized in Baton Rouge, La., to bring the total of active sections to 77. The latest addition to AWS will be known as the Baton Rouge Section and was formed to service this rapidly expanding industrial area. Planned new construction in the area is valued in excess of $500,000,000.

Officers of the section are: Claude H. Elbourne, Esso Standard Oil Co., chairman; Maurice J. Simpson, Louisiana Welding Supply Co., vice-chairman; Everett G. Smith, Louisiana State University, treasurer; and James M. Shilstone, Shilstone Testing Laboratory, secretary.

REGIONAL CONFERENCE

Boston, Mass.—The success of *Boston* Section's initial New England Regional Conference on Welding held Sept. 19, 1956, at New England Mutual Hall has assured its establishment as an annual event. In attendance were members and guests from all of the New England states. Registration for the technical session numbered one hundred and fifty and an equal amount were in attendance for the dinner and evening program.

Among the speakers at the Boston Section's Regional Conference Dinner on September 19th were the Messrs Sidney Low, Alan Rosenberg, G. O. Hoglund and Herb Turk

Speakers at the day-long session included Dr. H. Udin, Dr. W. F. Savage, J. S. Boudreau, C. E. Hartbower, Dr. H. Campbell and Dr. J. F. Parks. Each did an excellent job of presenting their subject in a most interesting manner with the result that the question-and-answer periods were so lively that in each case it was necessary to call a halt to maintain the time scheduled.

Speakers for the evening dinner meeting included G. O. Hoglund, 2nd vice-president AWS, who brought greetings from national headquarters; Sidney Low, director, District 1, who spoke on accomplishments in this area and plans for the future; Herb Turk, Section chairman, who expressed his appreciation of the committee's efforts in making the affair the success that it was.

Dr. Rocco D'Angelo, introduced as a professor of metallurgy from the University of Milan, Italy, gave an elaborate address on international affairs that at times bordered on the radical. When his statements reached the point of anarchy and the audience was about at the boiling point he broke into an Irish brogue and confessed that he was as phony as a three dollar bill.

The hilarious acceptance to this phase of the program seemed a fitting ending to what had been a most educational and interesting day.

INERT-GAS WELDING

Bridgeport, Conn.—On September 20th, 42 members of the *Bridgeport* Section heard a very interesting talk on inert-gas welding with emphasis on carbon-dioxide and consumable-electrode welding, as delivered by Daniel F. Zimmerman of the Bridgeport Lycoming, Avco Div., Stratford, Conn. A very attentive audience was particularly interested

SECTION MEETING CALENDAR

DECEMBER 3

LEHIGH VALLEY Section. Walp's Restaurant, Allentown, Pa. Dinner 6:30 P.M. Meeting 8:00 P.M. "Inert-Arc Welding," J. W. Cunningham, Air Reduction Sales Co.

DECEMBER 5

SUSQUEHANNA VALLEY Section. American Legion, Kingston, Pa. Dinner 6:45 P.M. Meeting 8:15 P.M. "Methods for Nondestructive Testing of Weldments," Robert G. Strother, Magnaflux Corp.

DECEMBER 7

NORTH CENTRAL OHIO Section. Dinner and meeting. Findlay Country Club, Findlay, Ohio. Section quiz with teams from: Dayton, Toledo, Stark Central and Cleveland.

DECEMBER 10

WASHINGTON Section. Joint meeting with Washington Chapter ASM. "Metallurgy of Ferrous Welding," Dr. R. H. Aborn, U. S. Steel Corp.

DECEMBER 11

DAYTON Section. Dayton Engineers Club, Dayton, Ohio. 8 P.M. "Brazing and Welding Aluminum," P. B. Dickeson and W. S. Hamilton, Alcoa. Illustrated with color sound movie.

DECEMBER 12

CLEVELAND Section. Hotel Manger, Cleveland, Ohio. "Resistance Welding Fundamentals, Applications and Its Future," J. F. Cantalin, Fisher Body Division, GMC.

DECEMBER 14

COLUMBUS Section. Seminar Series. "Contact Resistance and Its Control," Dean W. B. Kouwenhoven, Johns Hopkins University.

MILWAUKEE Section. Dinner 6:30 P.M. Meeting 8:00 P.M. Ambassador Hotel, Milwaukee, Wis. "Maintenance Welding," T. B. Jefferson, Editor, *The Welding Engineer*.

DECEMBER 17

PHILADELPHIA Section. Naval Architect's Night. "Structural Welding in Europe," C. E. Jackson, Linde Air Products Co.

Editor's Note: Notices for February 1957 meetings must reach Journal office prior to December 1, so that they may be published in January Calendar. Please give full information concerning time, place, topic and speaker for each meeting.

CHICAGO SECTION OPENS ITS 1956-57 SEASON

Scene at dinner preceding the September 21st meeting of the Chicago Section. Jay Bland, Section chairman, is at extreme left; Anton L. Schaeffler, technical speaker is in center; and L. C. Monroe, guest of honor for the evening, is at right. L. S. McPhee, who presented special award to Mr. Monroe, is shown between Mr. Bland and Mr. Schaeffler

Mr. Bland congratulates Mr. Monroe, who has just been presented with a wrist watch by Mr. McPhee

Mr. Schaeffler pictured during the delivery of his paper on "Metallurgy of Welding"

in the dual nozzle for tungsten-arc welding which Mr. Zimmerman developed.

METALLURGY OF WELDING

Chicago, Ill.—The September 21st meeting of the *Chicago* Section was designated as L. C. Monroe Night in order to pay tribute to "Chel" Monroe for all the years' service he has given to the Chicago Section. Mr. Monroe was presented with a wrist watch in appreciation of his service to the Section over the years. An overflow crowd was on hand for the dinner and the meeting which followed.

Technical speaker was Anton L. Schaeffler [M62], metallurgist, Welding Research, Allis-Chalmers Mfg. Co., whose subject was "Metallurgy of Welding." Mr. Schaeffler discussed the major factors that the welder must consider when he is welding mild steel, low-alloy steel, stainless steel and dissimilar steels.

Dinner was held at Milner's Restaurant and the meeting in the Auditorium of Peoples Gas Light & Coke Co.

CO_2-SHIELDED WELDING

Columbus, Ohio—The first meeting of the 1956–57 program of the *Columbus* Section was held at Williams and Co.'s new warehouse on September 14th. Ninety members and guests were present. Following a short business meeting the members were divided into two sections, one section watching the International Nickel Co.'s film, "Mining for Nickel," while the other section watched a demonstration by Frank Bernard [M62], and Nels Gillis, [M62], of Westinghouse Electric Corp. of the CO_2-shielded arc-welding process. Then the members watching the film were given the demonstration while the other members proceeded to the conference room to watch the film.

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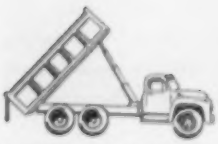

For some time, dump truck operators have cast longing eyes at the light weight and high payloads that aluminum dump bodies would make possible. But nobody knew how to weld aluminum bodies strong enough or fast enough.

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IDAHO
Boise
Pacific Metal Co.

ILLINOIS
Chicago
Machinery & Welder Corp.
Steel Sales Corp.
Moline
Machinery & Welder Corp.

KENTUCKY
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Williams & Co., Inc.

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COLUMBUS MEETING FEATURES CO_2 WELDING

General view of meeting held by Columbus Section on September 14th at Williams and Co.'s new warehouse

Part of group witnessing demonstration on CO_2-shielded consumable-electrode metal-arc welding being given by Nels Gillis (back to camera, pointing at welding machine)

EXECUTIVE COMMITTEE MEETING

Detroit, Mich.—The second executive committee meeting of the *Detroit* Section was held on August 28th. Committee members present were Bill Smith, Gordon Kirkwood, Larry Kendall, Ray Wolgast, Art Brown, Ray Wilcoxson, Ralph Zacharie, Len Broniak, Bill Jones, Walter Kroy, Jack Lemon, Al Lindsey, Roy Clarke, Jim Rainey and Harry Beronius.

The members were the guests of Porter Strother on board his schooner, *Sabot*. This was the 3rd annual cruise for the Detroit region. Dinner was served on board at 18:30 (6:30 P.M.) and was followed by a delightful sail on Lake St. Clair. Sixteen members were present and, surprising to all, no one had to be fished out of the lake.

ELECTRODE SELECTION

Appleton, Wis.—The *Fox Valley* Section held its September meeting at the Elks Club on September 21st. A sport picture was shown through the courtesy of the Miller Brewing Co. of Milwaukee.

Technical speaker was Jerome Hinkel (AWS), of the Lincoln Electric Co., Cleveland, Ohio. Mr. Hinkel thoroughly explained the electrode classification and the characteristics of each in his talk on "Selecting the Proper Rod for the Job." He emphasized, in particular, the relationship between the old styles of electrodes and the new iron-powder types. In addition, he showed typical uses of each and the increase in deposition obtainable with the new types.

WELDING OF STAINLESS STEEL

Glastonbury, Conn.—The first meeting of the *Hartford* Section for the 1956–57 season was held at the Villa Marie Hotel in Glastonbury on September 18th.

After cocktails and dinner, a talk was presented by Harry Reid, (AWS), of The McKay Co., York, Pa.

Mr. Reid spoke on the welding of stainless steels and his talk was one of the best that the Section has had the pleasure of hearing in some time. Mr. Reid is well qualified to

DETROIT EXECUTIVE COMMITTEE MEETS ON SCHOONER

Members of Executive Committee of Detroit Section who attended the August 28th meeting shown aboard schooner "Sabot" prior to dinner and sail

Gaiety and laughter were the rule among the members somewhere on Lake St. Clair during the night

speak on this subject. He covered all classes of stainless steel and problems related to each, and how some of them were solved.

The steak, as usual, was perfect and the fine talk by Mr. Reid kicked off what looks like a banner year for the Hartford Section.

PENSTOCKS AND TANKS

Des Moines, Iowa—The *Iowa* Section opened its first meeting of the year on September 19th with the newly elected officers, E. T. Looney, chairman; L. P. Faddis, 1st vice-chairman; A F. Busto, 2nd vice-chairman; J. T. Kilkenny, secretary and treasurer.

The buffet dinner at the Kirkwood Hotel was followed by a discussion by L. A. Perdue of Pittsburgh-Des Moines Steel Co., on "Erection and Fabrication of Penstocks and Surge Tanks for Fort Randell Dam Project." The discussion was augmented with color slides of this job. This program was followed by a plant visit to Pittsburgh-Des Moines Steel Co., which was conducted by L. E. Andeson, works manager and F. W. Songer, plant superintendent.

At the plant the visitors witnessed the forming and submerged-arc welding of 6-in. plates for the wind tunnel project at Tullahoma, Tenn.

Over 60 members attended the dinner and plant visit. The Section was very proud of this turnout to the first meeting of the year, considering that the total membership is only in the neighborhood of 70 members.

SOCIAL MEETING

Kansas City, Mo.—The meetings for the 1956–57 season of the *Kansas City* Section were opened with an enjoyable social meeting held at the World War II Memorial Building on September 14th. Refreshments supplied by the Goetz Brewing Co. was enjoyed by all present, as well as the delicious meal served by the catering service available at the Memorial Building. No organized program was sponsored, but the sociability and friendship developed at the meeting will give the Section more strength to carry on a strong program for the coming meetings.

HIGH-TEMPERATURE BRAZING

Huntington Park, Calif.—The first meeting of the Aircraft and Rocketry Panel, *Los Angeles* Section, for the 1956–57 fiscal year was held Sept. 6, 1956, at the Elks Lodge, 3355 Gage Ave., Huntington Park, Calif.

The attendance was quite gratifying to the new presiding officers, there being 79 members and guests in attendance, one of the largest turnouts that can be recalled for an opening meeting.

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AT THE SEPTEMBER MEETING OF THE IOWA SECTION

Members and guests of the Iowa Section having dinner prior to the meeting on September 19th

As part of the program, those in attendance visited the plant of the Pittsburgh-Des Moines Steel Co. Two typical scenes are shown above

The main speaker to participate in the evening's program was "Al" Thompson, general manager of Fabriform Metal Products, Inc., who presented a paper on "Modern High-Temperature Brazing." The text of Mr. Thompson's paper covered all phases of high-temperature brazing such as joint design, mechanical strength of brazed joint in conformity with service requirements, pressure-tight joints, electrical conductivity joints and brazed joints that require tests at elevated temperatures.

The contents of Mr. Thompson's paper was based on, and the results of, facts and data accumulated over a period of 20 years actual experience in high-temperature furnace brazing at Fabriform Metal Products and was well supported with slides.

On concluding his presentation, "Al" was presented with a desk pen in appreciation of the fine program rendered and as a momento of the occasion.

The "Coffee Talk" consisted of a film in color presented by Byron Russell AWS, of Airline Welding and Engineering Co. of Hawthorne, Calif., who with John Tolan AWS, of Research Engineering and "Uncle Milty" Sims AWS, of Absco Welding Supplies, took the viewers on a fishing trip to isolated spots in Alaska, a "Fisherman's

SPEAKS ON BRAZING

"Al" Thompson was the guest speaker at the 6th meeting of the Aircraft and Rocketry Panel in Los Angeles. His topic dealt with modern high-temperature brazing

C. B. Smith, Section chairman

ELECTED BY LOS ANGELES SECTION

FOR 1956-57 FISCAL YEAR

D. P. O'Connor, Section vice-chairman

J. B. Ross, Section secretary-treasurer

R. Hayes, chairman of Ways and Means Committee

M. Ochieano, chairman of Aircraft and Rocketry Panel

L. M. West, panel vice-chairman

H. Eubank, panel secretary

Paradise." The narration of the picture was well presented by Mr. Russell, telling of all their various experiences from the time they boarded a Western Airlines Plane in Los Angeles to take off on their trip, to when they caught all the fish and returned.

STRESS EVALUATION

Huntington Park, Calif.—The first dinner meeting of the *Los Angeles* Section for the fiscal year was held on Thursday, September 20th, at the Elks Lodge in Huntington Park, with 79 members and guests in attendance, including the following past chairmen of the Section: C. P. Sander, Alex P. Maradudin, Al Fenlason, Ed C. Williams, Chas. W. Johnson, S. R. Lanier and Francis V. McGinley.

The meeting was called to order by Charles Smith, assistant chief process engineer of the Douglas Aircraft Co., Long Beach Division, and new Section chairman. Mr. Smith opened the meeting by introducing his newly elected fellow officers; namely, D. P. O'Connor, program and vice-chairman; John B. Ross, secretary, and George Murphy, membership chairman.

Guest speaker was Alex Maradudin, chief metallurgist for the Standard Oil Co. of California. Mr. Maradudin also serves as an instructor in metallurgy for the University of California Extension Classes. His subject was "Evaluation of Stress in the Welded Area Through the Use of Polarized Light and Plastic Models."

Mr. Maradudin showed how the use of polarized light opens new fields in stress analysis through the determination of the location of stress concentrations and their magnitudes. He showed how transparent plastic models when subjected to loads typical of the structure they represent would change in transparency sufficiently to cause the formation of shadows at the stress concentration points.

With the use of slides, the principle was well illustrated and explained in detail by the speaker.

ELECTION OF OFFICERS

Los Angeles, Calif.—The *Los Angeles* Section and the Aircraft and Rocketry Panel recently elected its officers and appointed the needed committeemen for the forthcoming fiscal year. They were as follows:

Los Angeles Section

Chairman—C. B. Smith, Douglas Aircraft Co., Inc., Long Beach
Vice-Chairman—D. P. O'Connor, Los Angeles Water and Power
Secretary-Treasurer—J. B. Ross, American Platinum Works

Executive Committee

Program—D. P. O'Connor, Los Angeles Water and Power
Membership—George Murphy, Victor Equipment Co.
Education—Alan Flanigan, UCLA
By-Laws—Walter Tenner, U. S. N. Ordinance Test Station
Codes—Al Thompson, Fabriform Metal Products
Entertainment—John Wiley, Wiley Welding Supply
Ways and Means—Dick Hayes, Douglas Aircraft Co., Inc., Long Beach
Past-Chairman and Officer-at-Large—F. V. McGinley, Victor Equipment Co.

Special Committees

Technical—Frank Drahos, Byron-Jackson Co.
Technical Society Council—S. R. Lanier, Southwest Welding
Western Metals Congress—C. W. Concannon, Absco Welding Supplies
Publicity Chairman—Leo M. West, Douglas Aircraft Co., Inc., Long Beach

Aircraft and Rocketry Panel

Chairman—Mario Ochieano, Lockheed Aircraft
Vice-Chairman—Leo M. West, Douglas Aircraft Co., Inc., Long Beach
Secretary—Howard C. Eubank, Convair, Pomona
Membership—Stan Georgeson, Air Reduction
Past-Chairman and Officer-at-Large

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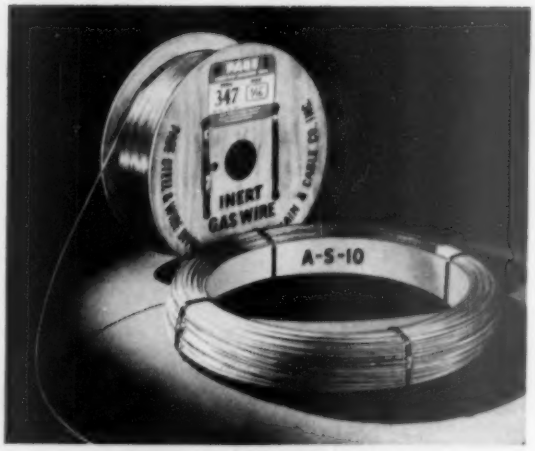

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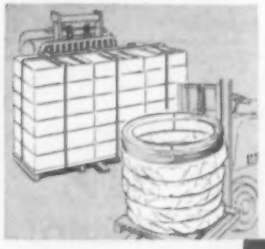

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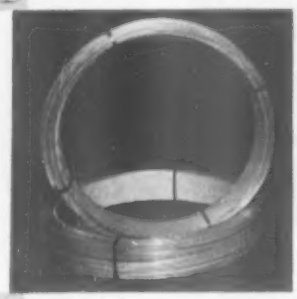
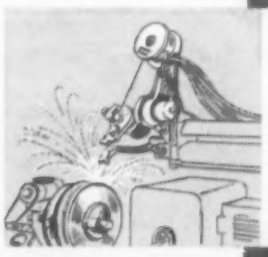


Welding Wire in Coils

PAGE A-S Automatic Welding Wire is regularly furnished in layer wound coils with cardboard liner, four Signode straps to facilitate coiling and easy unwinding.



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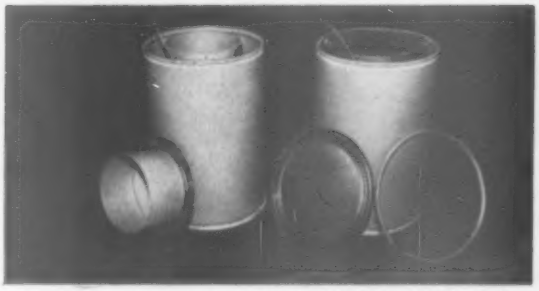
PAGE Inert Gas Welding Wire is available on reels: Precision thread-wound on twenty-five-pound, non-returnable reels to fit all popular inert gas welding machines.

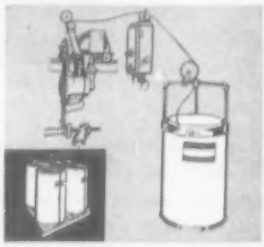
Gas Rod Packing

Gas welding rods are packed in 36" lengths in 50-lb. bundles—paper and burlap wrapped. Also in coils and reels (approx. 150 lbs.)—burlap wrapped. Stainless rods also come in 10-lb. fibreboard cartons.



LEFT: Pay-off-pak ready for filling, with "wire slinger" for uncoiling at extreme left. RIGHT: "Wire slinger" installed for feeding out wire; also, below, re-usable lid and retaining ring. Ring insures smooth feed-out of wire without snarls or kinks.

Sketch at right shows Pay-off-pak for continuous feeding up to 500 lbs. of wire without rethreading. Also (inset) lightweight Leverpaks. Both these containers protect against coil distortion... are easily opened, resealed, handled, stored.



PAGE Service Means Prompt Delivery From Local Stocks

You can get PAGE automatic arc welding wire, or oxy-acetylene welding rods quickly and easily from your nearby PAGE Distributor.

PAGE Distributors carry ample stocks from which your requirements can be filled without delay or inconvenience to you. This handy service not only saves you time in getting what you need, but makes it unnecessary for you to make a sizeable investment in inventory.

Send For These

Folder **DH-402A**—PAGE Submerged Arc and Inert Gas Welding Wire.

Booklet **DH-1277**—PAGE Gas Welding Rods.

Write our Monessen, Pa., office for *either or both*

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Production Development—James Jardene, Fletcher Aviation Corp.
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Brazing—Roy Omans, Superweld Corp.
Gas Welding—Lee Reay, Linde Air Products
Automatic Processes—George Foster, Associated Pipe and Engineering
Inspection—Bruce Baird, North American Aviation
Resistance Welding—Mike Marcoux, Douglas Aircraft, Long Beach Division

WELDING COSTS

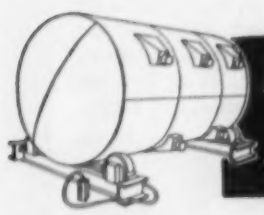
Louisville, Ky.—The new Kentucky State Fair and Exposition Center was the site of the first meeting this season of the *Louisville* Section held on September 25th. An attendance of 76 members and guests were present to hear Lew Gilbert [illegible], executive editor of Industry and Welding, speak on "Better Welding at Lower Cost."

The following new officers are now serving the members of the Louisville Section: Albert Pease, chairman; William Cochran, vice-chairman; Elmer Dilley, secretary; Chester Hare, treasurer; Arthur Thro, Clarence Schiller and Norman Boosey, directors.

STAINLESS-STEEL PANEL DISCUSSION

Madison, Wis.—The first meeting of the 1956–57 season and the start of the third year as a charter Section was held on September 13th by the *Madison* Section at Eagle's Clubhouse in Madison.

The dinner speaker, Bill Carow, is Madison's own contribution to the recent Winter Olympics held in Italy. Mr. Carow is a speed skater of national fame and did very well in the Olympics. His frank talk on customs and mannerisms of other contestants from various countries was very well received.



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cost no more than ordinary rolls!

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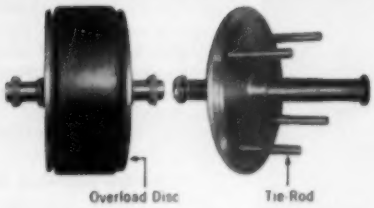

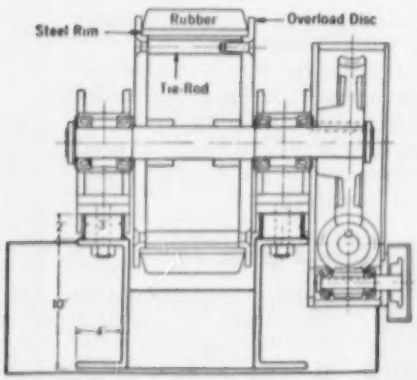

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- **TIE-ROD AXLE** design forms an effective axle as large in diameter as the O. D. of the steel tire rim.
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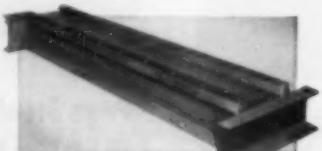

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KREIDLER ADDRESSES NEW JERSEY SECTION

C. L. Kreidler was the technical speaker at the September 18th meeting of the New Jersey Section

A large, attentive audience was on hand to hear Mr. Kreidler's talk on "Welding of Structural Steel"

The panel discussion held after a short intermission was very good. It brought comments and discussion from the floor on problems involving the working and handling of stainless steels. The panel, selected from various fields of industry, was well qualified to answer almost any problem arising from the members.

The panel consisting of Prof. Howard Atkins, of the University of Wisconsin, moderator; Raymond Knudtson [M62], Howard Rosenow [M62], Dwight Myers [M62], and E. Shevey.

COLD WELDING

New York Mills, N. Y.—The September meeting of the *Mohawk Valley* Section was held on September 13th in the New York Mills High School Auditorium.

Technical speaker was Howard Weller of the Utica Drop Forge & Tool Corp., Whitesboro, N. Y. Mr. Weller gave an excellent semitechnical talk on the subject of "Cold Weld."

There were two post-meeting speakers: National Secretary J. G. Magrath spoke on "The Yesterday, Today and Tomorrow of Welding and It's Importance in Industry." Also, he spoke on the "Importance of Strong Section Organization." F. J. Mooney, assistant national secretary, gave a general discussion on the "Organization and Operation of an Efficient Section."

STRUCTURAL-STEEL WELDING

Newark, N. J.—On Tuesday, September 18th, the *New Jersey* Section held its first regular monthly meeting for the 1956–57 season at the Essex House Hotel in Newark.

The premeeting dinner was served at 6:30 P.M. Chairman John Hila opened the meeting at 8:00 P.M.

Guest speaker for the evening was C. L. Kreidler [M62], of the Lehigh Structural Steel Co. Mr. Kreidler spoke on the "Welding of Structural Steel." With the help of slides and charts he carried his audience through several of the large projects recently completed by the Lehigh Co. He pointed out the weight saved by welding and the smooth profiles produced in a well-designed structure; evidence of this was shown by color slides.

The strength of welded structures was clearly demonstrated by a picture of a section of a radio tower dropped to the ground during erection, where through its tangled mass of several hundreds of welds, only one weld showed evidence of a crack.

Mr. Kreidler is a graduate of Lehigh University and has been employed by the Lehigh Structural Steel Co. since 1936. He is past-president of the Pennsylvania Society of Professional Engineers, chairman of the Lehigh Valley Section of AWS, and is a member of the AWS Committee on Building Codes.

A question-and-answer period was then conducted by H. C. Hoffman, followed by the usual snack and get-together.

WELDING CURRICULUM

New York, N. Y.—The first meeting of the *New York* Section for the fall session, was held on Sept. 11, 1956. A good program had been arranged and the speaker was Professor Roy B. McCauley [M62], in charge of the Department of Welding Engineering at the Ohio State University.

Professor McCauley emphasized that the Ohio State University was the only university in the country which has a special curriculum for welding engineers and that students, after five years of study, receive a degree in welding engineering. The audience was informed that a quite elaborate program, theoretical as well as practical, was in affect and that the engineers that have received their degree have obtained excellent positions on the strength of their background.

Professor McCauley showed a number of slides of the various departments at the University that were used for the welding classes and as well as their laboratories and libraries.

The talk was most interesting and clearly indicated that other colleges should follow the trend set by the Ohio State University thereby giving the welding engineer the recognition that he so well deserves.

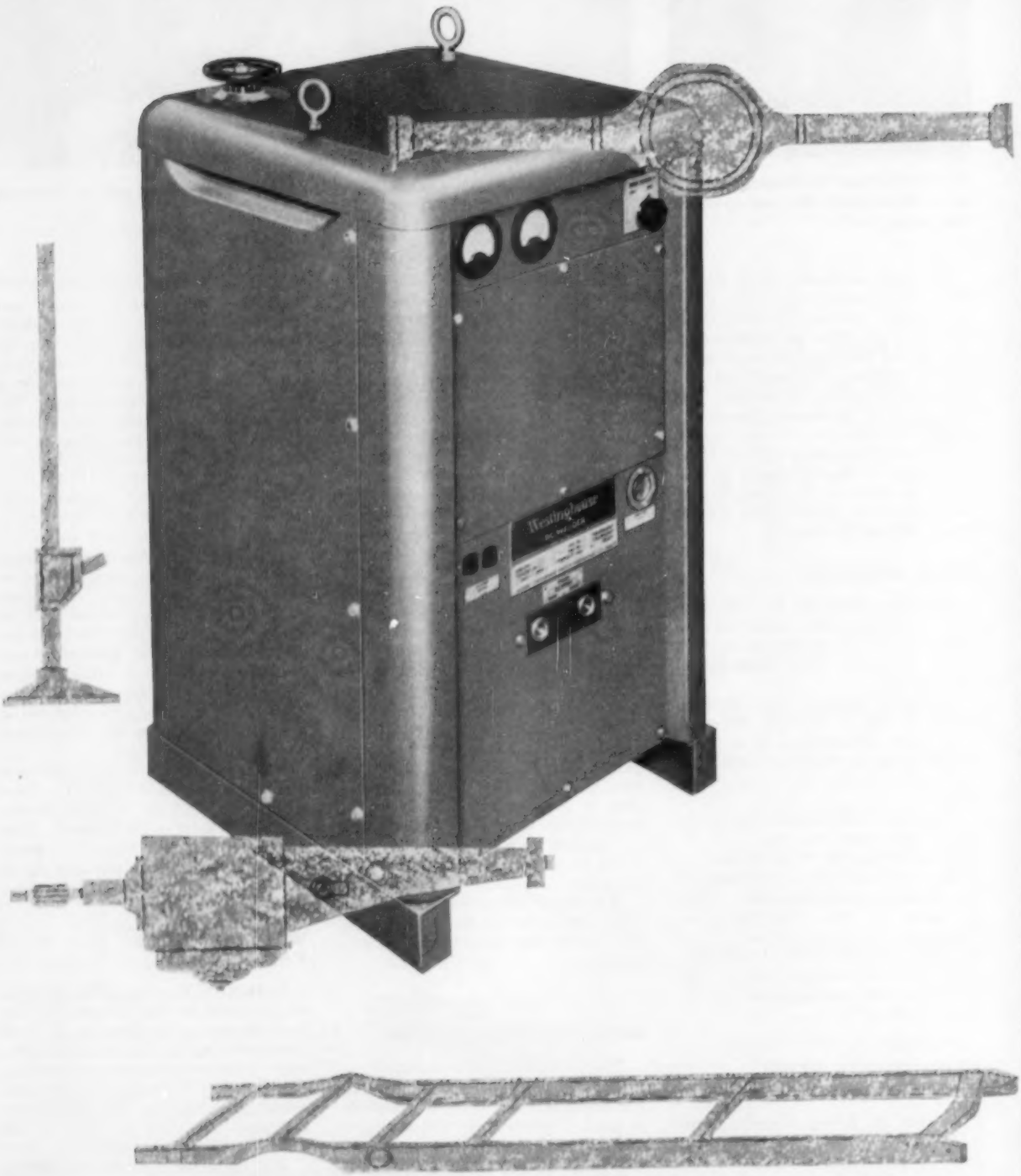
The meeting was held at Victor's Restaurant, 1 E. 35th St., New York City, and an excellent dinner was served prior to the Lecture. This new location is very centrally located for all members and an upswing in attendance is anticipated.

WELDED-PLATE FABRICATION

Buffalo, N.Y.—The first meeting of the season for the *Niagara Frontier* Section was a big success as Fred Plummer displayed his broad knowledge of plate fabrication in a talk on "Design for Welded-Plate Fabrication." The meeting, which 75 people attended, was held at Mann's 300 Club on Thursday, September 27th.

Mr. Plummer confined his talk to specific welding problems in shop-constructed and field-erected struc-

Automotive industry swings



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...to get 30% faster welds—at 50% less cost

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- Semiautomatic, automatic or spot welding
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All this—and at greater operating savings for you!

Call your local Westinghouse welding specialist today. He will be glad to show you how you can increase your high-volume weldment production with WEST-ING-ARC CO_2. Or, write to Westinghouse Electric Corporation, Welding Department, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21976-X

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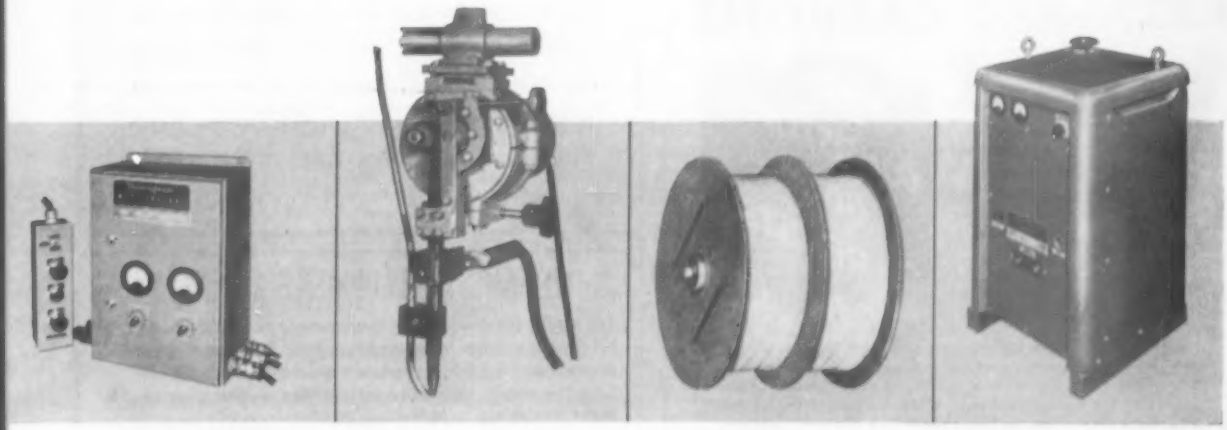

WEST-ING-ARC CONTROLS are housed in a NEMA Type 12 enclosure and conform to J. I. C. standards. The enclosure is dust-tight and contains a safety interlock which disconnects the control circuit when the door is opened.

HEAVY-DUTY WELDING HEAD includes a side-delivery nozzle to eliminate spatter and slag deposits. It consists of a reversible, variable, slow-speed ¼ hp frame motor, geared to a spur-type gear train, plus a knurled drive roll to feed the wire.

TYPE MS-21 WIRE is a mild steel copper-flashed wire specifically designed for use with carbon dioxide shielding gas. This is a high-quality welding wire with a vitally controlled analysis. It may also be used for inert gas welding (reverse polarity).

RCP WELDER supplies 600 amps at 34-volt load; is dependable and service-proved, like the Westinghouse RA welder. Current adjustments are automatically predetermined by the rate of wire feed. Output can be varied between 12 and 40.5 volts.

tures. Slides illustrating the application of welding in field construction were shown. His talk stirred much interest and a 30-min question-and-answer period followed.

PLANT TOUR

Tiffin, Ohio—The first meeting of the season of the *North Central Ohio* Section was held in Tiffin, Ohio on September 7th. Some 80 members and guests enjoyed a delicious dinner at the Shawhan Hotel. A film was shown entitled "Trends in Modern Forging." After a short business meeting the group enjoyed a plant visit of the National Machinery Co., one of the leading manufacturers of forging machines.

TECHNICAL PROGRAM

Philadelphia, Pa.—The *Philadelphia* Section announces its program of meetings for the remainder of the 1956–57 season as follows:

Nov. 19, 1956—"Inert-Arc Welding," Emil Myers, Graver Tank & Mfg. Co.

Dec. 17, 1956—Naval Architects' Night, "Structural Welding in Europe," C. E. Jackson, Linde Air Products Co.

Jan. 21, 1957—Past Chairman's Night, "Shop Management for Quality Welding," Lew Gilbert, Industry & Welding Magazine

Feb. 18, 1957—"Automation in the Field of Welding," John Randall, Ford Motor Co.

March 18, 1957—"Structural Welding Design," P. C. Kavanagh, Praeger-Kavanagh Engineers

Apr. 8–12, 1956—National Meeting in Philadelphia

May 25, 1957—Annual Dinner-Dance at the Germantown Cricket Club, R. W. Thomas, chairman

INSPECTION TOUR

San Jose, Calif.—The *San Francisco* Section initiated its fall activities with an inspection of Food Machinery & Chemical Corp.'s Ordnance Division facilities at San Jose on Sept. 24, 1956.

Meeting at Vahls in Alviso for dinner, the group was addressed by Michael Sebastian [redacted], welding engineer of Food Machinery & Chemical Corp. He gave a brief summary of the work done at their plant with particular emphasis on the fabrication of the M-59 Armored Personnel Carrier. The M-59's primary purpose is to protect the infantryman from fragments and small arms fire, and is used to carry the wounded from battle field. It is also used to transport men from output stations or command headquarters.

Following dinner the group proceeded to the plant for an inspection of the facilities and a close look at the equipment and manufacturing practices. Since welding is extensively used in building the armor plate hull and other parts of the carrier, various processes were observed or described: regular coated-electrode manual welding; shielded-inert-gas metallic-arc welding; tungsten inert-gas welding of aluminum; new spot resistance welding on aluminum and steel; flash-butt welding; submerged arc welding; and the new tungsten-arc aluminum-cutting apparatus.

While touring the plant, the group also inspected the ground handling equipment that Food Machinery has designed and manufactured for North American Aviation for the Navajo Guided Missile.

PANEL DISCUSSION

Philadelphia, Pa.—The *Philadelphia* Section held the first two of its panel discussions on October 5 and November 2. The dates and the

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KEEN-ARC CARBONS

FOR CONSISTENTLY GOOD RESULTS

Designed to carry the high currents necessary for intense heat, BBB Keen-Arc Carbons produce a fine-grained weld of high tensile strength. They give a smooth, steady "flowing" flame which does not wander and which is concentrated at the desired focal point. Flame temperature is easily and accurately adjusted by merely changing the ampere input, and heavy copper coating permits gripping at extreme ends—eliminates frequent and periodic resetting.

A COMPLETE LINE OF CARBON WELDING SUPPLIES including carbon and graphite electrodes, carbon rods and plates, welding paste, etc. Write for catalog.

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WELDING DEVELOPMENT ENGINEER

To supervise welding development research projects, investigate shop problems resulting from new welding procedures and to prepare research reports.
One or more years experience in welding development desirable. Metallurgical Engineering Degree or Mechanical Engineering Degree with welding major or equivalent. Location, Schenectady, New York.
Excellent employee benefits. All replies kept confidential. Send detailed résumé and salary requirements to:

Mr. G. Y. Taylor, Manager
Employee Services Department
ALCO PRODUCTS, INC.
Schenectady 5, New York

subjects for the remainder of the discussions are given below:

December 7, 1956—"Titanium and Its Fabrication"
January 4, 1957—To be announced
February 1, 1957—"Why Single Phase? Why Three Phase? Resistance Welding Discussion"
March 1, 1957—"Torch, Tungsten Arc, and Furnace Brazing. Where and Why?"
April 5, 1957—"Automatic Hard Facing and Overlay"

PLANT TOUR

Pittsburgh, Pa.—Some 105 members and guests of the *Pittsburgh* Section thoroughly enjoyed a conducted tour through the new research center of the U. S. Steel Corp. in Monroeville, Pittsburgh, on September 21st. Arrangements were made through vice-chairman W. D'O. Doty of U. S. Steel.

WELDING CONTROLS

Saginaw Valley, Mich.—The September dinner meeting of the *Saginaw Valley* Section was held on September 13th at the High Life Inn, with 89 members and guests present for the dinner and meeting.

Guest speaker was Stuart Rockafellow (MW), vice-president and chief engineer of Robotron Corp., Detroit, Mich. In an exceptionally well-planned and extremely interesting talk, Mr. Rockafellow highlighted the present uses, limitations and future of the ignitron tube, discussing its place in present-day timing circuits and limitations in future controls where split-cycle precision timing is required.

He also presented a look toward the future indicating possible control changes such as diode transistors to replace ignitron tubes in high-speed repetitive welding where the de-ionization time of the ignitron tube becomes a limiting factor.

Examples of short duration or percussion welding were cited such as in the tin can industry where fractional cycle welding is employed.

SPEAKS ON CONTROLS

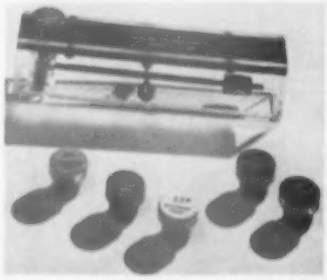
Stuart Rockafellow, right, is being congratulated by Saginaw Valley Section chairman Robert F. Woollard, center, after his excellent talk on "What's New in Welding Controls." W. F. Williams, vice-chairman, is looking on

STAINLESS STEELS

Toledo, Ohio—The first meeting of the *Toledo* Section for the 1956–57 season was held at the Maumee River Yacht Club, Tuesday, Sept. 18, 1956. Following a delicious meal that was attended by 42 members, the new officers were introduced and the tentative program for the new season outlined. The Toledo Section is building its program around the people that do the work and is striving to bring in speakers who will teach new methods rather than sell patent procedures.

The main speakers for the evening were D. W. McDowell (MW), and H. Bott (MW), of the International Nickel Co., who talked on "Welding of Stainless Steels and High-Nickel Alloys." Because of time limits, these men attempted to cover a very broad subject in a very short time and did an excellent job of it. The members were pleased with the presentation and kept both men busy after the meeting answering individual questions. Seventy-one members attended the meeting.

FERRITE INDICATOR



Ferrite Indicator is a simple, rugged, non-destructive inspection instrument developed for laboratory, shop, and field use. Go no-go feature permits instant acceptance testing of austenitic stainless and manganese weld and base metals. Requires no external standards, no adjustments, no visual readings, and is unaffected by position. Performs equally well on sheets, plates, rods, irregular shaped objects, and individual parts of complex components. Effective in locating areas of high and low ferrite content in heterogeneous products.

- Indicator covers all practical welding requirements; inserts being available in the range of 1.5% to 15% ferrite.
- Indicator weighs but three ounces and is 5" long. All metal components are bright nickel plated and the Indicator is furnished in a handsome hardwood box.

Write today for complete details.

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Engineering Company, Inc.
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P. O. Box 944 Annapolis, Maryland

ELECTRODES AND ELECTRODE COATINGS

Wichita, Kan.—The September dinner meeting of the *Wichita* Section was held on September 10th at Sidman's South Seas.

Speaker was Harry F. Reid, Jr. (MW), manager of Technical Service, The McKay Co., York, Pa.

Mr. Reid's talk entitled "It Isn't Mud" was directed specifically to electrodes and electrode coatings.

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PRESSURE VESSEL ENGINEERS

Degree plus 5 years' minimum experience on heat transfer equipment and pressure vessel design of equipment used in oil refinery or chemical plants. Rapidly expanding engineering firm with long range outlook. Good salaries and excellent working conditions. Write giving qualifications to:

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Half Page	170.00	155.00	145.00	130.00
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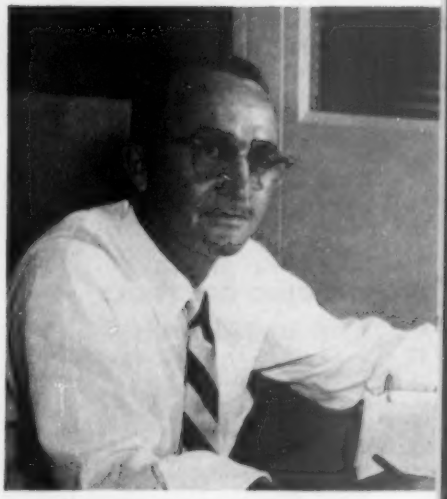
CONSTRUCTION MACHINERY

Why Clark a-c arc

Using a General Electric a-c arc welder, Alvis Kirk of Clark Equipment Co. welds the hinge plate of a bucket-carrier assembly for a Michigan tractor shovel. Though made for heavy duty, the assembly must be built to a tolerance of $\pm\frac{1}{16}$ inch.



T. E. LYONS, assistant purchasing agent

This clean, sturdy weld, made in a difficult position, binds one of 10 bosses to the hinge plate. The General Electric a-c arc welders easily handle the tough job of welding the plate of hard steel without undercutting the mild-steel boss.

. . . on a tough

At Clark Equipment Company's modern Pipestone Plant in Benton Harbor, Mich., more than 20 General Electric a-c arc welders are used to weld the Michigan line of tractor shovels and other heavy-duty construction machinery.

This demanding welding job calls for sturdy, stress-carrying welds made to close tolerances. Several difficult positions and many different kinds of steel complicate things further. Why this job was turned over to General Electric a-c welders is explained by four members of Clark's production team:

Alvis Kirk, welding operator—"I like the General Electric a-c arc welder because it's always ready to go. I like the quick-shift range feature which

Finished product, the Michigan model 175-A tractor shovel, loads a bin car. In manufacturing this shovel and other heavy-duty machinery at the Pipestone Plant, Clark uses G-E a-c welders.

DIVISION OFFICIALS TELL YOU . . .

Equipment Company uses General Electric welders in building heavy-duty shovels

JACK G. PAUL, welding engineer

NICK J. WHITE, superintendent of maintenance

welding job, G-E a-c welders prove versatile, reliable, economical

allows it to go from high to low current or the reverse, and it's very good about holding an even heat. I must weld vertical-up, vertical-down, and other difficult positions, but I never have any trouble holding a steady arc."

Jack G. Paul, welding engineer—"With the General Electric a-c arc welder ..... there is no arc blow to bother with. Arc striking is instant, and the stepless current control and logarithmic scale give a very fine setting. The large scale in front of the welder enables the operator to see the setting from a distance without leaving his work. And the 'Hi-Lo' range switch quickly adapts the machine to many different applications. The current adjustor on top makes it easy for the operator to set current. In our shop we need machines that keep downtime to a minimum, and General Electric a-c welders meet this requirement."

T. E. Lyons, assistant purchasing agent—"I like the General Electric a-c welder because of its ready acceptance by our plant engineers and welding operators. Its price is competitive, and the engineering assistance given by General Electric in applying the welders to solve our various welding problems is invaluable. Delivery of spare and repair parts is excellent."

Nick J. White, superintendent of maintenance—"The General Electric a-c arc welder ..... it is simple to take apart. We blow out the machines every three months and have had no service difficulties with any of our 20 500-amp machines during the past two years. And, if needed, replacement parts are available on short notice. The electrical switchgear is rigid and heavily built, and the machine has a good ventilation system. Method of power-factor correction on these machines helps us maintain an over-all plant power factor of 88 per cent."

The Pipestone Plant is only one of many users for whom General Electric a-c arc welders have shown their value for heavy-section, high-current welding. If you would like more information on General Electric a-c arc welders, contact your nearby General Electric welding distributor (listed in the yellow pages of your phone book), or write for bulletin GEA-6243A to Section 711-6, General Electric Company, Schenectady 5, N. Y.

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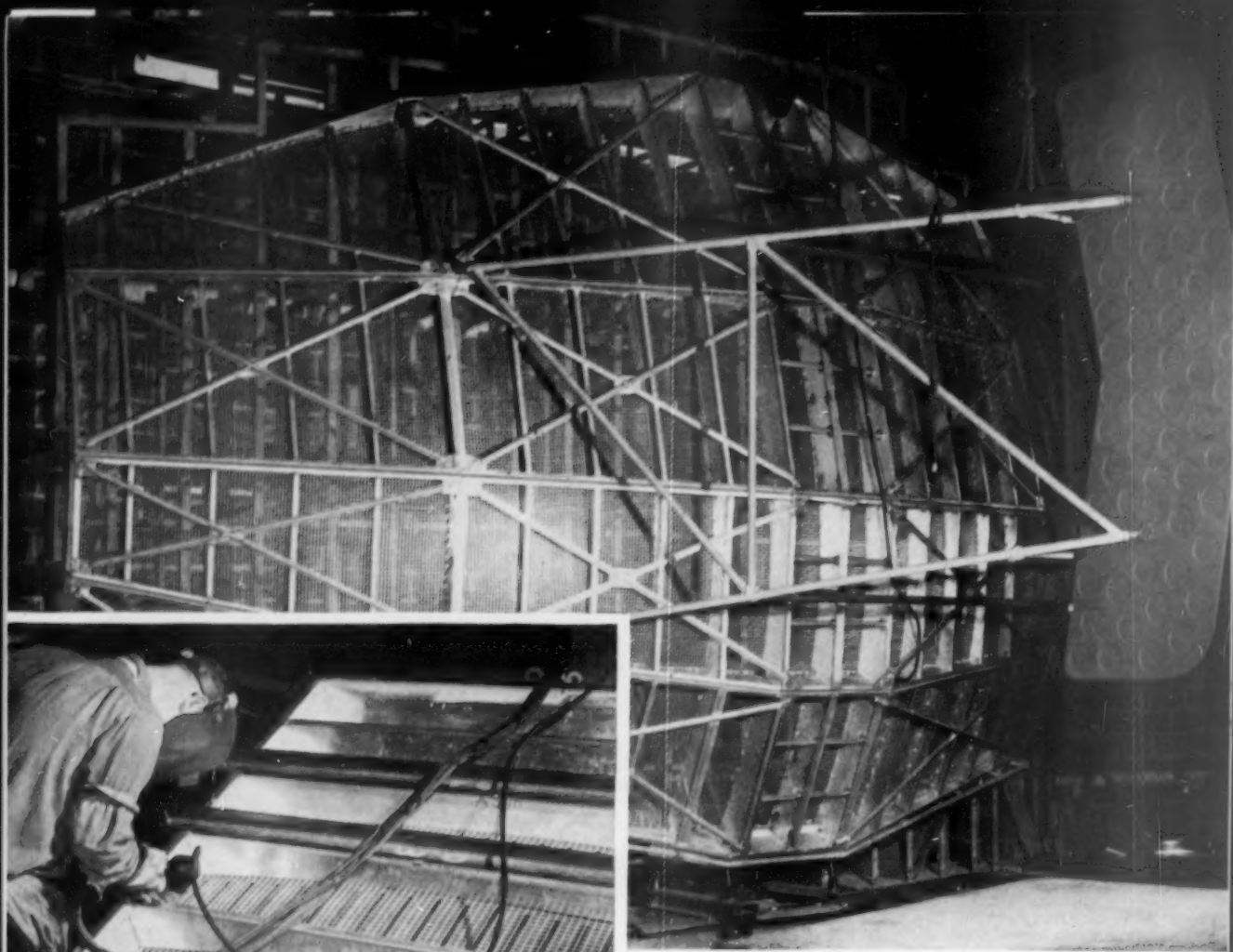

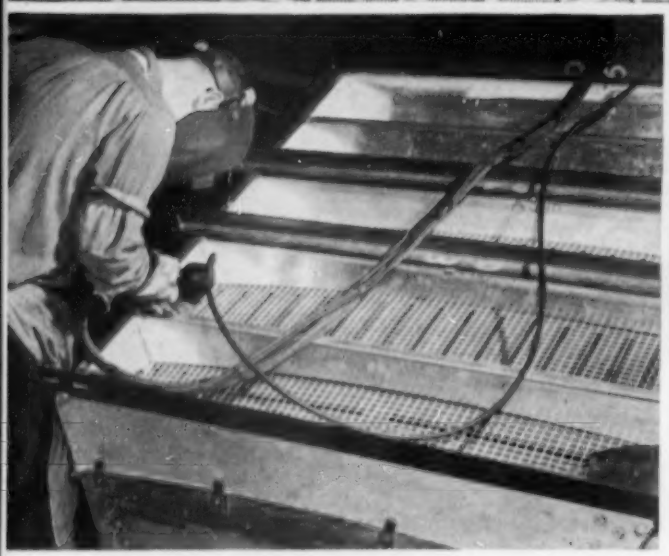

Completed aluminum radar antenna (above) stands more than 20 feet high at the Garden City, Long Island, plant of General Bronze Corporation. At left, a welding operator uses General Electric Fillerarc* equipment to weld $\frac{1}{32}$" diameter aluminum screen to an antenna section frame—a tough welding job because all welds must be sound enough to support the weight of the antenna under constant buffeting from the wind.

Fillerarc* welding of radar antennae is 10 times faster, costs 25% less

Fabricating giant, aluminum radar antennae can be a costly and time-consuming operation. But General Bronze Corporation of Garden City, N. Y., has found that compared with the tungsten-arc method formerly used, it can speed such welding 10 times while cutting costs 25 per cent with General Electric Fillerarc gas-shielded, consumable-electrode equipment.

Requirements for welding the antennae are demanding. Each antenna is composed of sections of varied size and shape, which must be assembled to form the completed unit. Materials used range from $\frac{1}{8}$" aluminum frame to $\frac{1}{16}$" cross channels and $\frac{1}{32}$" diameter aluminum screen.

*Registered trademark of the General Electric Co.

Preliminary tests using semi-automatic Fillerarc equipment resulted in strong, smooth welds, and the trouble and expense of cleaning up flux was eliminated. So, General Bronze now uses Fillerarc welding equipment on all its antenna work and is looking for other jobs Fillerarc can do faster and at less cost.

And, Fillerarc is versatile. It can weld mild and stainless steel, bronze, nickel, and magnesium. For more information on how Fillerarc can save you time and money, call your nearby General Electric welding distributor (see the yellow pages of your phone book), or write for bulletins GEC-989 and GEC-1334 to Section 713-6, General Electric Co., Schenectady, N. Y.

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Estock, C. T. (C)
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Wilson, William A. (B)

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LeBlanc, Caliste (C)
Maher, William (C)
Meyers, Donald E. (C)
Provencher, Alfred (C)
Taylor, Paul W. (C)
Walker, Stanley L. (C)

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Burke, George W. (B)
Cash, M. (C)
DelGiudice, Joe (C)
Eichorn, J. J. (C)
Harris, Chester A. (C)
Howland, Richard L. (C)
Jakubowski, Richard S. (C)
Mongan, W. (C)
Reinhardt, Roland E. (C)

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Funke, Donald C. (C)
Riebel, Robert A. (B)
Shotwell, George T. (B)

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Joseph, Robert (C)
Nelson, Bertil G. (C)
Simmons, Robert O. (C)
Wittenmyer, R. F. (B)

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Thomsen, Theodore R. (B)
Watling, Nelson E. (B)

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Gongaware, K. S. (C)
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Lee, James Kenneth (B)
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Norris, Robert C. (B)
Shireman, William K. (B)
Smith, Harold E. (B)
Starks, LeWayne O. (B)

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Crosby, R. Allen (C)
Edwards, A. J. (B)
Kalapach, Joseph J. (B)
Morris, Francis X. (B)
Musil, Leonard M. (C)

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Foxall, Robert H. (B)

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Fenzel, Calvin H. (C)
Troy, William J., Jr. (B)

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Tucker, Donald G. (B)
Wisneski, Joseph Henry (C)

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Higgins, James C. (B)
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Joyce, Arthur T. (C)
Rolfes, Herbert H. (B)
Romano, Richard (B)

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Hudson, Randolph A. (B)
Kloeblen, Emil M. (B)
Strother, Robert G. (B)
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Douglas, W. G. (C)
Emerson, Glenn (C)
Grubbs, C. B. (C)
Lloyd, Ray (C)
McDonald, Richard (C)
Olnhausen, Walter B. (C)
Roy, Joseph (C)

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Monk, Dale B. (C)

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Mohr, W. T. (C)

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Hanna, Richard Ellis (B)
Larwig, Frederick F. (C)
Schmodt, Robert E. (D)
Streets, T. Robert (C)

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Fairley, W. F., Jr. (B)

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McElhaney, Tim H. (C)
Scott, Robert (B)
Sturm, Robert D. (C)
Wegner, Kenneth R. (B)

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Craddock, William D. (B)
Frager, Harry (C)
Liese, Frank L. (B)
Martin, Joseph Philip (C)
McKiernan, James J. (B)
Parrott, Raymond S. (B)
Rile, Wallace S. (C)
Ryan, John A. (C)
Schulez, Joseph A. (C)
Tennant, Gerald L. (C)
Wiley, Richard T. (B)

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Cunningham, Floyd (B)
Dahlke, Howard Edward (B)
Jackson, Robert W. (B)
Parker, George W. (B)
Piccardo, F. A., Jr. (B)
Reagan, Edward J. (A)
Rothrauff, Regis G. (B)
Trees, George S. (B)
Webster, Phillip A. (C)

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Hogan, Arnold F. (C)

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Martin, Calvin M. (C)
Snow, Bert W. (B)
Zvara, Albert (C)

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Meyer, Milton E. (B)

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Labagh, Richard E. (B)
Partch, Newell T. (C)
Tydell, Ernest (C)
Wolley, Ross (C)

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Rogers, Jack R. (B)

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Mash, Donald R. (B)
Nelson, Frank D. (C)

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Hargrove, Robert M., Jr. (A)
Murphy, Earl T. (B)

SUSQUEHANNA VALLEY

Sitler, Derl (B)

TOLEDO

Johnson, Earl T. (B)
Wilhelm, Herbert (C)

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Cannon, George R. (B)

TULSA

Cosan, K. Wayne (B)
Ellis, Duane G. (C)

WESTERN MASS.

Cerow, Joseph A. (B)
Lemoine, Gerard (C)
Lindahl, Frederick M. (B)

WICHITA

Davis, Lyle A. (B)

YORK-CENTRAL, PA.

Nickey, C. Dillon (B)
Wiley, Louis R., Jr. (B)

NOT IN SECTION

Bush, Albert P. (B)
Ford, John William (A)
Green, Stanley Edward (B)
Roitman, A. (B)
Smith, Thomas (B)
Takeuchi, Katuyoshi (B)

Members Reclassified

During the month of September

BOSTON

Cole, Clarence E. (C to B)
Hogaboom, Allen G. (C to B)

CHICAGO

Gurtner, Francis B. (C to B)
Monroe, L. C. (C to B)

CINCINNATI

Davis, B. J. (C to B)
Pugacs, Myron A. (C to B)

CLEVELAND

Herrick, Clayton B. (C to B)
Ritchie, Dave (C to B)

COLUMBUS

Ryan, Robert S. (C to B)

DETROIT

Richard, Florian (C to B)
Vogel, Roger (C to B)

EAST TEXAS

Du Bose, John B. (C to B)

HARTFORD

Rusch, Richard (C to B)

MARYLAND

Tyminski, Edward S. (C to B)

NEW JERSEY

Burchfield, W. F. (B to A)
Detlor, L. T. (C to B)

NORTH CENTRAL OHIO

Long, Terry (C to B)

NORTHWESTERN PA.

Lentz, John S. (C to B)

OKLAHOMA CITY

Suhre, Fred L. (C to B)

PHILADELPHIA

Daly, William J. (C to B)

PITTSBURGH

Fritsche, M. H. (C to B)
Hilberg, Felix W. (C to B)

PORTLAND

Focht, Orville A. (C to B)

SALT LAKE CITY

Hill, Don William (C to B)

SAN FRANCISCO

McIntyre, Basil D. D. (C to B)

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Made of Kaiser Aluminum— one-third lighter than copper!

Twice as easy to handle—To reduce fatigue and increase job efficiency.

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ABSTRACTS OF CURRENT PATENTS

prepared by Vern L. Oldham

Printed copies of patents may be obtained for 25c from the Commissioner of Patents, Washington, D. C.

2,760,197—Welder's Helmet—Charles Jones, Cincinnati, Ohio.

This novel welder's helmet has, as a special feature therein, the provision of a spark guard member secured to a head ring of the unit. The spark guard is adapted to fill the space between the head ring and the shield provided above the eyes of a person wearing the shield. This guard thus catches any sparks entering the upper portion of the helmet above the welder's eyes when the shield is operatively positioned.

2,760,796—Weldable Hollow Body—George V. Woodling, Rocky River, Ohio.

2,760,797—Weldable Stud Element—George V. Woodling, Rocky River, Ohio.

In these patents, Woodling covers different types of weldable elements, one of which has an end provided with outer and inner annular walls radially spaced from each other and defining an annular recess. Flux means is positioned in the recess and a cap is provided for the recess and engages the walls to be positioned thereby. The second weldable element has an end provided with a flux receiving recess therein and a cap over such recess. Separate means extend beyond the cap on the weldable element and secure the cap to the element.

2,761,046—Automatic Arc Welding Viewing Mechanism—James Elder Herrick and William Wilson Herrick, Stamford, Conn.

This patented welder's mask has electrical means for moving the eye shield of the mask to a closed position. Other circuit means are provided so that the closing of the eye shield is a prerequisite to the closing of the welding circuit so as to insure protection of the welder's eyes before welding action commences.

2,761,047—Joining Aluminum and Aluminum Alloy to Titanium and Titanium Alloy—Harlan L. Meredith, Norwalk, Calif., assignor to North American Aviation, Inc.

This process comprises placing the special metals to be welded in abutting relationship and playing an inert-gas heating arc over surface areas adjacent such abutted portions of the metals to heat them to temperatures below the fusion temperatures of aluminum and/or titanium. Then an aluminum-base filler metal is added to the abutting joint edges so that such filler metal is brazed to the titanium metal and welded to the aluminum metal.

2,761,049—Water Cooled Sigma Guide Tube—Thomas McElrath and Arthur P. Scheller, Chatham, N. J., assignors to Union Carbide and Carbon Corp., a corporation of New York.

This patented tube is for use in inert-gas-shielded metal-arc welding action. The tube has special cooling means provided in association therewith.

2,761,050—Method of and a Feed Drive for the Regulation of the Spark Gap in Metal-Working Machines—Carl Ballhausen, Krefeld, Germany, assignor to Deutsche Edelstahlwerke Aktiengesellschaft, Krefeld, Germany.

This patent relates to the regulation of the narrow spark gap between an electrode and a metal workpiece in metal-working apparatus wherein such workpieces can be worked with removal or corrosion of material by sparking between the electrode and the workpiece. The control method comprises operating a unidirectional rotation electric motor in driving relation with a mechanical reversing drive for the electrode and controlling the reversing drive by a relay. The relay in one position is connected across the spark gap and in the other position to a source of constant comparison voltage so that the drive is rendered inoperative when the spark and comparison voltages are equal but which feeds the electrode to narrow or open the gap when one or the other of the voltages predominates.

2,761,796—Electric Gouging Tool—Rene D. Wasserman, Stamford, Conn., assignor to Eutectic Welding Alloys Corp., New York, N. Y., a corporation of New York.

This patent relates to a fluxing and ionizatio.' producing composition for use in electric-arc flame surfacing and finishing applications. The composition comprises specified proportions of ferrous carbonate, graphite and zircon. Silicate-containing materials, cyrtolite, cellulose and manganese also are present in the composition.

2,761,800—Method of Forming P-N Junctions in N-Type Germanium—Norman H. Ditrick, East Orange, N. J., assignor to Radio Corporation of America, a corporation of Delaware.

This method relates to the fusing of an indium body to a surface portion of an n-type germanium body and it comprises placing an indium-zinc body in contact with a germanium body and heating the surface portions thereof. The bodies have a fluxing material therebetween capable of producing hydrochloric acid when heated. The heating is at a temperature exceeding the melting point of the indium-zinc body and above the decomposition temperature of the fluxing material.

2,761,892—Welding Cable Coupling or Connection—Robert H. Newell, Lynwood, Calif.

Newell's welding cable connection comprises the combination of two aligned welding cable ends, each composed of a plurality of helical wound smaller cables. The cables are composed of plurality of relatively finer strands and the cable ends are in telescoped engagement with each other to form a tangled mat composed of the finer strands extending in opposite directions. Nuts are in threaded engagement with opposite ends of the coupling and are adapted to compress the intermingled finer strands into contact with each other to form a large area of contact between the cable ends.

2,761,951—Indicating Apparatus for Flash Welding Machines—Hans Alfred Schlatter and Emil Wegmann, Zollikon-Zurich, Switzerland, assignors to Firma H. A. Schlatter A. G., Zollikon-Zurich, Switzerland.

This patented indicating apparatus is for use with a flash welding machine and indicates the amount of movement of the carriage, carrying the article to be welded, with relation to the frame support of the machine.

2,761,952—Welding Frame—Luther D. Totten, Long Beach, Calif.

Totten's patented frame relates to apparatus for axially aligning and flash or pressure welding the adjacent ends of two pipe sections or equivalent members.

2,761,953—Replaceable Tip Welding Electrodes—Robert E. Kerr, Detroit, Mich.

Kerr's patented electrode includes a body portion having a bore therethrough and a replaceable tip with a bore therein communicating with the body bore to form a coolant chamber. A special O-ring seal is provided between the electrode body portion and the tip for providing a fluid tight seal between such members when secured together.

2,761,954—Apparatus for Welding—Clifford M. Westfall, Homewood, Ill., assignor to Chicago Bridge & Iron Co., a corporation of Illinois.

This patent is on welding apparatus for use on a generally horizontal joint between

Plant, Research Laboratories and World Headquarters

BETTER FASTER

Low Temperature EUTECTIC WELDING ALLOYS

STRONGER WELDS

EUTECTIC Welding News

PUBLISHED BY EUTECTIC WELDING ALLOYS CORPORATION, 40-40 172 STREET, FLUSHING 58, NEW YORK, N. Y.

EUTECROD 144 REMOVES CAST IRON WELD HEADACHES

Eutectic's research and consistent efforts to eliminate cast iron weld "headaches" have produced two completely new welding rods, EutecRod 144FC Super and EutecRod 144 Super, which promise to make cast iron repair routine.

Repair of cast iron has always required considerable welding skill. The weldor often had to use a scraper to work out sand, gas pockets, and porosities. Weldors found that conventional welding rods did not produce deposits of sufficient density to overcome these defects.

In the past, Eutectic's research eased some of these difficulties. Now EutecRod 144FC Super and EutecRod 144 Super dispense with the scraper and permit even inexperienced weldors to handle diverse cast iron repairs in all positions. With EutecRod 144, the weldor can easily control the molten filler metal. These new rods produce extremely dense weld deposits which are easily machinable and have good color match. Blow holes, sand inclusions, and gas pockets are prevented. EutecRod 144 does not require fusion of the base metal and is applied at the lowest possible base metal heat.

These rods are ideal for repair of breaks in castings, building up missing sections, and repairing machining errors. They allow the welding of unusually thin sections. Ultimate tensile strength is 50,000 psi.

WORLD-WIDE EUTECTIC WELDING INSTITUTE CLASSES

Eutectic's growing world-wide program of service to industry continues with the introduction of Eutectic Welding Institute classes in Hawaii, New Zealand, and Australia. The classes, which explain the newest techniques and applications of "Low Heat Input" welding, drew praise from weldors and leaders of industry.

Weld Savings Application Reports were particularly well-received by such industries as the government-owned airlines in Australia. Pioneered by Eutectic and prepared by Eutectic welding specialists, this report recommends improved welding practices for lowering production and maintenance costs. Free reprints of these reports for various industries (TIS 2605) are available from Eutectic District Engineers or from Eutectic's Technical Information Service.

EUTEC-CHAMFERTRODE CUTS LABOR COSTS BY OVER 85%

Removal of excess and old or defective weld metal is made easy with Eutec-ChamferTrode. An owner of a fabricating company successfully used Eutec-ChamferTrode to dismantle and re-assemble a large order of scaffolding forms. With conventional methods, half the forms would have been lost. With Eutec-ChamferTrode, the forms were cut apart with minimum effort, no loss of forms, and no clean up or dressing before re-welding. Labor costs were cut by over 85%.

Eutec-ChamferTrode for ferrous or non-ferrous metals has a special exothermic coating. It concentrates the force of the arc right at the point of application, yielding a highly efficient metal removing tool. Finishing is rarely necessary; an ideal surface is left for further operations.

NINE MONTH WORK STOPPAGE PREVENTED

Use of EutecTrode 680 AC-DC recently saved two Utah coal mines $3,400 on replacement parts. A 12 foot diameter high test nickel iron spurring gear on the company's only dryer had 180 worn down teeth. Replacement would have meant a nine month complete work stoppage.

Repairs were made without any "downtime" with EutecTrode 680 AC-DC. In rebuilding the worn teeth to original size, the weldor ran short beads, skipping around and keeping the casting cool enough to touch at all times. No machining required.

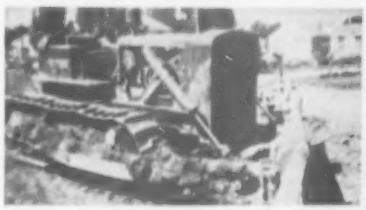
EutecTrode 680 AC-DC is an all purpose, corrosion resistant electrode that permits deposits free from porosities, spatter and undercutting. Welds are deposited at highest possible speeds with least amount of base metal heat, using lowest possible amperage. Ultimate tensile strength is up to 120,000 psi.

"EUTECTIC'S" DR. BLANC SPEAKS ON BRAZING

Dr. G. M. A. Blanc, of Eutectic's European research affiliate, recently spoke on production brazing before the International Welding Society's 1956 meeting in Madrid.

Dr. Blanc demonstrated that the total cost of an assembly is lowered by using a high quality filler metal, despite its higher unit price. He established that brazing is the best solution for diverse manufacturing problems, fulfilling all technical and cost requirements. Write for a free copy of "Productivity by Brazing," (TIS 2635).

OPERATING COSTS CUT FROM $1.10 TO 33c PER HOUR



A highway construction company found the protective pads attached to their tractor grousers wearing down in less than 225 operating hours. As the best means of reducing this costly wear, EutecTrode 10 was selected. An extremely easy to apply "Frigid Arc" coated electrode, it resists severe abrasive wear and gives a lasting hardness with great corrosion resistance. After using EutecTrode 10, the company found their tractor pads in excellent condition after 530 operating hours and estimated they would receive at least 400 more service hours. Operating costs were reduced from $1.10 to 33 cents per hour.

EUTECTRODE 1851 CUTS "DOWNTIME" BY ONE-THIRD

Continuous failure to prevent cracking of castings with conventional welding materials led an eastern railroad to experiment with EutecTrode 1851.

Repeatedly, EutecTrode 1851 has proved its great resistance to cracking in welding steel, iron, copper alloys, stainless steel, nickel and nickel alloys. Its rapid deposition permits high speed welding and produces homogenous welds. It is ideal for dissimilar metals and dissimilar thicknesses.

Use of EutecTrode 1851 by the railroad produced a non-porous, high strength deposit. No cracking has occurred.

EUTECTIC WELDING ALLOYS AT POWER SHOW

Visit Eutectic's Booth 214 at the Power Show, New York Coliseum, November 26-30.

"EUTECTIC" WELDING HEADLINES • TIME-MONEY-MACHINERY SAVERS

When welded aluminum must meet exacting standards...severe service

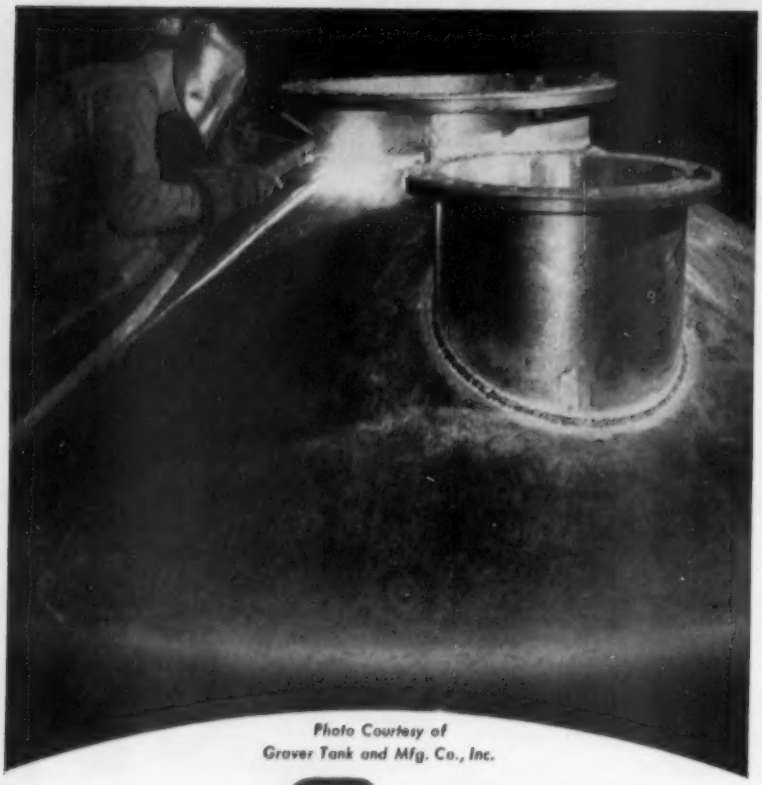


Photo Courtesy of Graver Tank and Mfg. Co., Inc.

WELD WITH ARCOS

ALUMINUM RODS and ELECTRODES

The inert-gas-shielded-arc process made aluminum welding practical . . . but it takes Arcos quality in aluminum bare wire to assure you the most dependable results possible. Because no flux is used, the chemical analysis and cleanliness of the wire must be within exacting limits. Arcos' long experience with weld metallurgy, plus rigid controls in manufacturing, guarantee this vital factor. Arcos aluminum wire is your best assurance of stronger, more ductile, more corrosion-resistant welds.

ARCOS CORPORATION, 1500 S. 50th St., Philadelphia 43, Pa.

upright plates. The apparatus comprises a pair of rollers having their peripheral surfaces inclined to the plate and having an edge in contact with the plate. A flexible endless belt is mounted tautly around the rollers and has one run thereof in contact with the plate for simultaneous movement of the belt with rotation of the rollers and relatively stationary contact between the contacting run of the belt and the plate. Other means are provided for feeding flux and welding wire to the joint just above the belt and still another member is provided for traversing the belt along the plate.

2,761,955—Electrical Arc Welding—Roger W. Sholle, Lorain, Ohio, assignor to Gregory Industries, Inc., Detroit, Mich., a corporation of Michigan.

A method of joining a first metal member to a second metal member is disclosed and all of the joining steps are performed from the same side of the metal members. The method comprises bringing the members into surface contact and placing the end of an electrode against the first member after which the first member and electrode are connected in series in an electric circuit to establish a flow of electrical current through the first member and the end of the electrode. Then the electrode is retracted to establish an electric arc. This arc is maintained until the adjacent portions of the members are heated to molten temperature due to the heat of the arc and the molten material becomes a part of the adjacent portions of the members. Thereafter the flow of current is stopped to extinguish the arc and allow the molten metal to solidify and complete a weld joining the members with the electrode maintained in a retracted position until the weld is completely solidified.

2,761,956—Automatic Electric Welder—Stewart H. Potter, Sierra Madre, and James M. Nuding, Reseda, Calif., assignors to North American Aviation, Inc.

The patented apparatus is for electric arc seam welding and the apparatus includes an electrode, a welding circuit connected to the electrode and a voltage sensing means to sense the arc voltage between the electrode and a workpiece. Hydraulic means are connected to the electrode so as to maintain an essentially constant arc link between the electrode and the workpiece as the electrode is moved with respect to such workpiece.

2,761,957—Electrical Arc Welding and Tool Therefor—Roger W. Sholle, Lorain, Ohio, assignor to Gregory Industries, Inc., Detroit, Mich., a corporation of Michigan.

This patent is on a tool for electric arc spot welding of metallic workpieces and comprises a body, an electrode carrier slidably mounted in the body for holding an electrode, and a foot on the body for application to an exposed face of a workpiece. Yieldable means normally project the electrode carrier, and an electrode therein, beyond the foot so that when the foot is applied to the work the electrode is pressed against the work. The electrode can be retracted with relation to the foot, and catch means are provided for holding

the carrier retracted when desired.

2,762,048—Welding Helmets—John Modin, Vancouver, British Columbia, Can.

This patented welding helmet has means therein for urging the visor to a closed position.

2,762,049—Automatic Electric Arc Viewing Helmet—William Wilson Herrick and James Elder Herrick, Stamford, Conn.

In this patented arc welding viewing mechanism, a shield is provided and a dark lens carrying member is provided in pivotal relationship with the shield for movement to and from a viewing opening provided therein.

2,762,193—Welded End Closure Means for Rocket Motors—Carl E. Johnson, Verona, Pa., assignor to Scaife Co., Pittsburgh, Pa., a corporation of Pennsylvania.

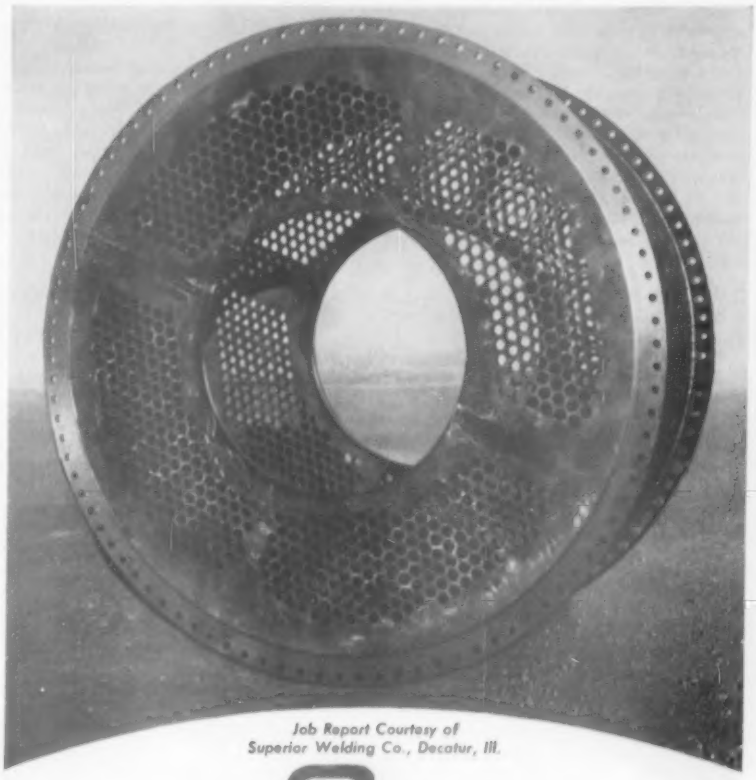
This patented gas-generating device comprises a metal container open at one end and with a charge of ignitible gas generating material in the container. An end closure is provided in the open end of the container, while a body of heat insulating material is provided in the container between the end closure and the charge. Such end closure has a part extending away from the charge and welded to the container at a distance from the charge so that during welding the temperature of the container adjacent the end of the charge nearest said end closure is less than the ignition temperature of the charge.

2,762,892—Electrical Induction Welding Method and Apparatus—Harwood E. Park, Venice, Calif., assignor of one-third to Gerald H. Peterson, Santa Monica, Calif.

This patent relates to an induction heating apparatus for butt-welding two pieces of metal positioned in edge to edge relationship in a welding zone. The apparatus comprises an inductor extending only parallel to the adjacent edges of the pieces of metal adjacent the welding zone longitudinally thereof and means comprising leads connect to each end of the inductor and a single conductor for high-frequency current to energize the inductor with high-frequency current to create alternating loops of magnetic flux about the inductor and to induce eddy currents in the edges of the metal pieces parallel thereto. Laminated ferromagnetic means are provided to extend around three sides of the inductor away from the welding zone and with pairs of poles being directed toward the zone on the fourth side of the inductor. The gap between the poles is substantially greater than the sum of the gaps between the individual poles and the metal in the welding zone to cause the flux loops to link with the edge portions of the two pieces of metal in the zone to create eddy currents in such edge portions. The ferromagnetic means has grains therein insulated from each other by high temperature resistant silicon dioxide insulation.

2,762,902—Electrode and Roll Assembly for Tube Mills—Ralph L.

How to get trouble-free service from welded stainless equipment



Job Report Courtesy of Superior Welding Co., Decatur, Ill.

WELD WITH ARCOS

STAINLESS ELECTRODES

This heater or calandria section of a finish evaporator used in the food and chemical industries is made of Type 316 stainless plate. Equipment such as this must resist the corrosive attack of the acids in the liquids being processed. ARCOS Chromend KMo (Type 316) Electrodes were selected because of their known ability to produce sound weld metal that defies the destructive action of sulphuric, acetic, and similar organic acids. For trouble-free weld metal—easily deposited—use ARCOS Electrodes.

ARCOS CORPORATION, 1500 S. 50th St., Philadelphia 43, Pa.

Hankin, Holland, Ohio, assignor to The Etna Machine Co., Toledo, Ohio, a corporation of Ohio.

Hankin's patent relates to an electrode and roll assembly for tube mills and it comprises a transformer casing that is traversed by the tube to be seamed. A transformer is provided on this casing and a pair of welding electrodes are connected to the transformer for movement therewith. Other means are provided for adjusting the transformer casing to alter the position of the electrodes in directions longitudinally, vertically and laterally relative to the tube. Three adjustable pressure rolls are also provided in the apparatus and are adjustably positioned therein for engaging the tube blank.

2,762,904—Method of Making Flash Welded Joint—Jesse B. Thomas, Louisville, Ky., assignor to Reynolds Metals Co., Louisville, Ky., a corporation of Delaware.

Thomas's method of joining tubes relates to those having enlarged diameter end bores to provide internal shoulders and the method comprises inserting a sleeve having a ceramic electrically nonconducting surface into the tubes and with the ends of the sleeve being exteriorly tapered. Deformable gaskets are placed into the tubes adjacent to the shoulders and the tubes are compressed together into end abutting engagement for forcing the gaskets into the tapered spaces around the ends of the sleeve. Simultaneously the abutting ends of the tubes are flash welded together.

2,762,947—Welding Device—Jan Anthonie Van Bergen, Eindhoven, Netherlands, assignor to Hartford National Bank and Trust Co., Hartford, Conn., as trustee.

This patented welding device comprises at least two Z-shaped welding rod holders having welding rods therein. Means are provided for automatically replacing one of the welding rods in contact with the workpiece with the other of the welding rods after the one welding rod has been consumed to a given length. Special guide members complete this patented welding device.

2,763,057—Cold Pressure Welding of Metal Foil—Verne Clair, Jr., Levittown, N. Y., assignor to Koldweld Corp., New York, N. Y., a corporation of New York.

This patent is on a method of welding a plurality of relatively thin metal members of cold pressure weldable material having a thickness of less than about 0.030 in. and the method comprises superimposing the members with the portions to be joined in contacting relation and an indenting pressure is applied to a plurality of substantially identical uniformly spaced welding areas upon one face of the contacting portions. This pressure is so applied to these special areas so as to produce a solid phase welding bond and to deform the welded portions of the members into a uniformly crinkled shape of increased mechanical strength.

2,763,058—Process of Producing Steel-Aluminum Bi-Metal Strip—William E. McCullough and Wilbur E. Wyatt, Detroit, Mich., assignors to Bohn Aluminum and Brass Corp.

This patent relates to a process of producing a bi-metal strip of steel and aluminum alloy suitable for being subsequently fabricated into bearings. The process comprises placing two strips in a protective atmosphere and bringing the heated strips together with the strip of aluminum alloy being in contact with a nickel plated side of a steel strip. The two heated strips are bonded together by pressure which causes a reduction of between 33 to 40% in the thickness of the aluminum alloy strip.

2,763,755—Electric Arc Welding—Harold J. Graham, Highland Park, Mich., assignor to Graham Manufacturing Corp., Detroit, Mich., a corporation of Michigan.

Graham's patent relates to means for controlling a welding tool which has spacing means for establishing an initial gap between the two workpieces to be welded and electric motor means for contacting them upon receiving a seating impulse. A normally open welding circuit is provided and includes the gap between the workpieces, and current supply means are provided for discharging through this gap. A normally deenergized ionizing circuit supplies high frequency energy to the gap while a normally open seating circuit supplies seating impulses to the motor means. The apparatus also includes a control circuit that has timing relay means for first closing the welding circuit and then energizing the ionization circuit and then closing the seating circuit to actuate the motor means by providing a seating impulse therefor. The control circuit finally disconnects its own energy supply for resetting of the device.

2,763,756—Induction Welding—Wallace C. Rudd, Larchmont, and Robert J. Stanton, Brooklyn, N. Y., assignors to Magnetic Heating Corp., New Rochelle, N. Y., a corporation of New York.

This new method is for welding together two opposed edge portions of metal when the metal edges are longitudinally advancing from a spaced apart relation with an elongated V-shaped gap therebetween into abutting relation at the weld point. The metal is heated along the opposed edge surfaces by high-frequency electromatic induction action characterized in that on each approaching edge a high-frequency heating current is maintained following and closely confined to a path extending from a starting point adjacent the edge on its upper surface, along adjacent such edge for a substantial distance, then down across the edge surface to the under surface near the edge and then back along such edge to such under surface to a point thereon under the starting point. Finally such current flows up across the edge surface to the starting point. These currents

for worn truck bottoms, skips, chutes and hoppers
MANGANAL
11%-13½% MANGANESE-NICKEL STEEL
HOT ROLLED PLATES
Write For Complete "Easy-to-do-it" Details
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TUNGSTEN ELECTRODES

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Now—at no extra cost—all Sylvania Tungsten Electrodes are supplied with *color coded* ends. You can tell the type of rod at a glance, even if the carton has been lost or destroyed.

Never again will you have to scrap used lengths of rod because you can't identify them. And never again will you risk ruining a costly job because of using a wrong electrode. With Sylvania's new color coding—you'll always know *for sure* what rod you have in your electrode clamp!

Add to color coding, the many other advantages of Sylvania Tungsten Electrodes . . . and you'll agree they're your best buy! Only Sylvania has the *complete* line—four types of electrode, each designed to do a specific job in shielded arc welding.

Whether you use atomic hydrogen, helium or argon in your arc welding . . . you'll find that the four dependable Sylvania Tungsten Electrodes will meet almost any condition you may encounter.

Sylvania Tungsten Electrodes are supplied with chemically cleaned or centerless ground finish. Order them in handy color coded packages of ten from your welding supplies distributor. For further information write to:

SYLVANIA ELECTRIC PRODUCTS INC.
Tungsten & Chemical Division
Towanda, Pa.

SYLVANIA

Lighting • Radio • Electronics • Television • Atomic Energy

are maintained inductively with sufficient strength to heat the edges to welding temperature by positioning conductor portions carrying high-frequency current along the desired current lines.

2,763,768—Welded Joint and Method and Apparatus for Producing Same—Ralph J. Coffey, York, Pa., assignor to American Chain & Cable Co., Inc., Bridgeport, Conn., a corporation of New York.

This method relates to a method of producing a welded joint having a cross section on a plane perpendicular to the joint faces in which the interfaces between the parent metal not affected by heat and heat-affected metal intersect to make a substantially hourglass figure. The method comprises positioning slugs of metal too large to enter the joint when cold on opposite sides of the joint parallel thereto, applying pressure to the slugs to force them into the joint, and simultaneously passing a welding current from one of the slugs to the other through the joint faces for welding action.

2,763,769—Resistance Welding Apparatus—John J. Childs, Detroit, Mich., assignor to Ford Motor Co., Dearborn, Mich., a corporation of Delaware.

This new type of a resistance welding apparatus includes a welding transformer and a second transformer connected in series across an alternating current source. Means shunt the second transformer to energize it for welding action, and an air valve solenoid is provided for closing the welding points. Other circuit means connect a pilot light in the circuit so that it will glow if the welding transformer is energized while the air valve solenoid is de-energized.

2,763,770—Welding Apparatus and Method—Perry C. Arnold, Chicago, Ill., assignor to Chicago Bridge & Iron Co., a corporation of Illinois.

This patented welding process is for use on an upstanding shell and includes the steps of holding the ends of a longitudinally extended strip to the ends of a horizontal area of the shell and deforming a portion of the strip toward the shell to press it to the shell regardless of curvature and irregularities in the shell. Then flux is placed on such deformed portion of the strip and the shell is horizontally traversed with the welding arc submerged under the flux provided.

2,763,771—Single Phase Rectifier Arc Welder—Harry J. Bichsel, East Aurora, N. Y., assignor to Westinghouse Electric Corp., East Pittsburgh, Pa., a corporation of Pennsylvania.

This arc-welding apparatus includes supply conductors connected to an alternating current supply, load conductors for connection to the welding electrode and work, and a main rectifier circuit between the supply conductors and the load conductors for supplying direct current for welding under normal current conditions. An auxiliary rectifier circuit is provided and the apparatus is characterized by such circuit having a reactor connected directly between the rectifier of that circuit and the load conductors.

2,763,811—Power Source for Arc Welding—Clifton S. Williams, Pittsburgh, Pa., assignor to Westinghouse Electric Corp., East Pittsburgh, Pa., a corporation of Pennsylvania.

Williams' arc-welding apparatus comprises a pair of conductors between which an arc for welding is to be produced, a high-voltage low-power supply adequate to fire an arc for welding, and a low-voltage high-power supply, the voltage of which has a magnitude at least equal to the potential across an arc and the power delivering ability being sufficient to maintain a welding arc once it is fired and to produce adequate heat for welding. Members are provided in the apparatus for connecting the high-voltage supply between the conductors, and other means connect the low-voltage supply also between the conductors for effecting the desired welding action.

Tempilstik° FOR ALL HEAT-DEPENDENT OPERATIONS

looks like a crayon... marks like a crayon... tells temperatures like a precision instrument!

Available in these Temperatures (F.)

113	375	1000
125	388	1050
138	400	1100
150	413	1150
163	425	1200
175	438	1250
188	450	1300
200	463	1350
213	475	1400
225	488	1450
238	500	1500
250	550	1550
263	600	1600
275	650	1650
288	700	1700
300	750	1750
313	800	1800
325	850	1850
338	900	1900
350	950	1950
363		2000

Sixty-three different compositions enable you to determine and control working temperatures from 113° to 2000° F.

TEMPILSTIK° marks on workpiece "say when" by melting at stated temperatures — plus or minus 1%.

ALSO AVAILABLE IN LIQUID AND PELLET FORM . . . WRITE "WELDING SALES" DEPT. FOR SAMPLE TEMPIL° PELLETS . . . STATE TEMPERATURES OF INTEREST—PLEASE!

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Spooled... layer wound to assure a smooth, even feed. Sizes: .035", .045", 1/16", 5/64" and 3/32" diameters.

Coiled... layer wound on rims for submerged arc welding. Sizes: 1/16", 5/64", 3/32", 1/8", 5/32", 3/16" and 1/4" diameters.

Cut Lengths... straightened and cut wire furnished in 36" lengths for inert arc and gas welding.

Sizes: .035", .045", 1/16", 5/64", 3/32", 1/8", 5/32", 3/16" and 1/4" diameters.

Two factors give

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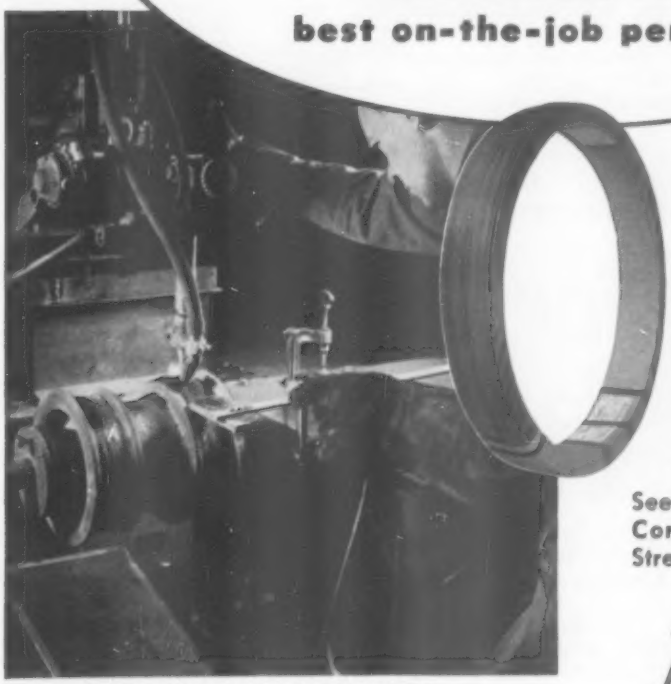
WELDING WIRE

best on-the-job performance



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Coiled... precision drawn for perfect roundness to insure continuous, smooth feed with any automatic head. Available in six Types for hard-facing applications.

Drawalloy welding wire is a product of two factors—years of experience in the welding industry combined with the best wire mill drawing practices. The result is clean welding wire with the proper finish, temper, diameter tolerance and chemical analysis. It's a wire that produces the highest quality welds continuously—with an easy, sure feed and a constant, smooth arc.

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CORPORATION

The Wire Mill For The Welding Industry

YORK, PENNSYLVANIA

NEWS of The Industry

NEW RESEARCH LABORATORIES

Pictured above is the modern entrance to the new research laboratories of National Carbon Co., a division of Union Carbide and Carbon Corp., Parma, Ohio. The new laboratory, which was officially dedicated on September 18th, contains approximately 175,000 sq ft of floor space and is located near the center of a 126-acre plot on Snow Road in Suburban Cleveland

Saginaw Welding Incorporates

Saginaw Welding Supply Co. of Saginaw, Mich., was formed Apr. 1, 1942, as a partnership owned by James N. Alcock and his wife, Rose J. Alcock. On Sept. 1, 1956, a $100,000 corporation was formed. The new officers are: James N. Alcock, president; Robert P. Gehring, vice-president; and Rose J. Alcock, secretary-treasurer.

Mr. Gehring was brought into the firm to expand the company's operation in automatic welding. He was formerly connected with Westinghouse Electric Corp. and with Cayuga Machine & Fabricating Co., Inc. Also, he has been a very active member of the AMERICAN WELDING SOCIETY. In 1952–53, he was chairman of Niagara Frontier Section.

Robert P. Gehring

Saginaw Welding Supply Co. is a distributor for many leading firms and represents many of the nation's leading manufacturers of welding accessories industrial and safety supplies.

Mr. Alcock is also vice-president and treasurer of Wolverine Gas Products, Inc., of Saginaw, Mich. Wolverine is Saginaw's only manufacturer of industrial gas, such as oxygen, acetylene and nitrogen.

Fifth Expansion for All-State

All-State Welding Alloys Co., Inc., has announced completion of the company's fifth expansion of its White Plains, N. Y., center for research, development and manufacture of alloys and fluxes for the welding shop or department. Previous expansions were in 1947, 1950, 1951 and 1953.

It is estimated that the 1956 building program has added a third to the company's capacity.

Additional construction is now in the planning stage. It will be primarily to double or better capacity for extruded alloys to weld aluminum and to multiply facilities for flux-coating bronze.

AT ALL-STATE OPEN HOUSE

J. H. Grimsey, president, White Plains Chamber of Commerce, congratulates Tom Nast, president, All-State Welding Alloys Co., Inc., at Open House celebrating completion of company's fifth expansion program. *Left to right:* J. C. Bailey, Civic and Business Federation of White Plains; D. J. Mastellon, County Trust Co.; Mr. Hast, D. Cruikshank, Consolidated Edison; Mr. Grimsey; R. H. Mandel, All-State; R. Wilson, Air Reduction; and K. V. Lutz, All-State

Wagner Mfg. Co. Renamed Lenco, Inc.

In order to avoid firm-name confusion, Paul J. Leonard, president of the Wagner Manufacturing Co., Inc., of Jackson, Mo., manufacturers of welding accessories, announces that the board of directors has authorized changing the company name to Lenco, Inc., effective Sept. 1, 1956.

Their trade name, Hi-Amp, has been granted registration rights and hereafter will identify all welding accessories manufactured by the Company. Wagner Manufacturing Co., Inc., was founded in 1948. There has been no change in management personnel.

COMING EVENTS

A Calendar of Welding Activity

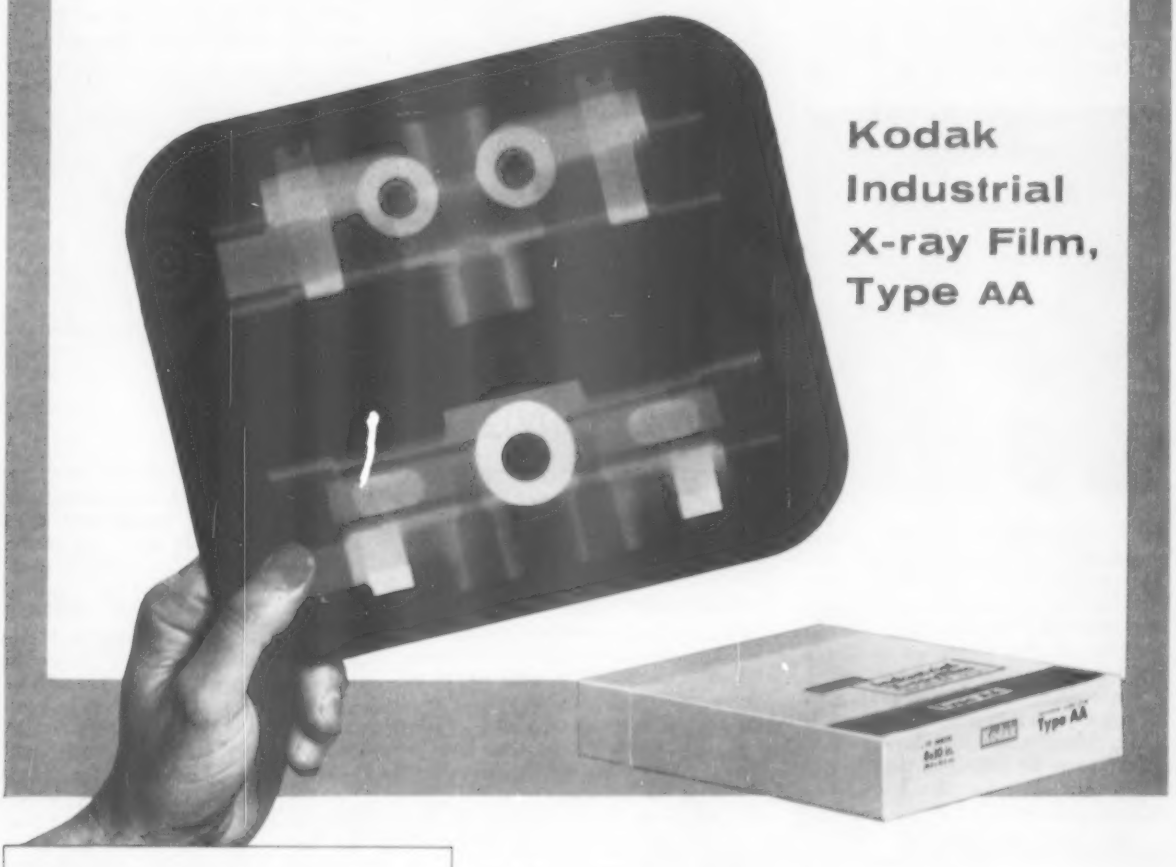
AWS National Meetings
- 1957 Spring Meeting and Welding Show:
- April 8–12, Hotel Sheraton, Philadelphia, Pa.
- April 9–11, Fifth Annual Welding Show, Convention Hall, Philadelphia, Pa.

NWSA Zone Meetings
- Southeastern Zone Meeting:
- December 3–4, Dinkler-Tutwiler Hotel, Birmingham, Ala.
- Southwestern Zone Meeting:
- December 6–7, Statler-Hilton Hotel, Dallas, Texas.

Midwest Conference
- Jan 30–31, 1957, Midwest Welding Conference, Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

New X-ray Film

gives greater detail with usual exposure times



Kodak Industrial X-ray Film, Type AA

Read what the new Kodak Industrial X-ray Film, Type AA, will do for you.

- Reduces exposure time—speeds up routine examinations.
- Provides increased radiographic sensitivity through higher densities with established exposure and processing technics.
- Gives greater subject contrast, more detail and easier readability when established exposure times are used with reduced kilovoltage.
- Shortens processing cycle with existing exposure technics.
- Reduces the possibility of pressure desensitization under shop conditions of use.

Now your x-ray dealer can supply you with this new x-ray film that gives you greatly increased speed. This gives you the opportunity of using reduced kilovoltage to obtain greater radiographic contrast, and easier readability with established exposure times.

And in addition to ranging up to more than double the speed, this new film retains the fine sensitivity characteristics which have made Kodak Type A the most widely used x-ray film in industry.

Kodak Industrial X-ray Film, Type AA, will save you time. It can produce finer work. Get in touch with your x-ray dealer or Kodak Technical Representative and see how.

EASTMAN KODAK COMPANY
X-ray Division
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Kodak
TRADE MARK

Westinghouse Names Three to Arc-Welding Post

The appointment of Fred J. Purdy as sales manager of Westinghouse Electric Corp.'s arc-welding department at Buffalo, N. Y., has recently been announced. Mr. Purdy succeeds A. J. Hendry, who is now sales manager for the standard control division in Beaver, Pa.

Mr. Purdy graduated from Bowdoin College in 1932, and attended Harvard Business School and the Boston Uni-

versity Law School. In 1952 he was appointed New England regional manager as supervisor of welding products, and in 1954 became section manager of welding machine sales. He is a member of the AMERICAN WELDING SOCIETY.

Succeeding Mr. Purdy as section manager of welding machine sales is D. L. Maus, who had held a welding sales post in the Philadelphia area since 1953. Mr. Maus has been with Westinghouse since 1947.

Also announced was the appointment of John H. Glass, Jr., as purchasing agent for the welding department. A graduate of St. Lawrence University and the Harvard Business School, he has been with the purchasing department of the Westinghouse air conditioning division since 1954.

G.E. Tube Department Fills Key Positions

General Electric Power Tube Department has established six key positions in the manufacturing section of the Schenectady tube plant, announced D. C. Scott, manager of manufacturing for the department.

Appointed to fill the positions are: Walter H. Beers, manager of camera and storage tube manufacturing; Bruce E. Belnap, manager of metal tube, tank rectifier and tube parts; John H. Goodrich, manager of quality control; Arthur A. Kehrer, manager of power rectifier equipment; Robert E. Steward, manager of equipment engineering and facilities; and Hugh E. Thomson, manager of klystron and traveling wave tube manufacturing.

Nelson Announces Appointments

Appointments of Raymond C. Scheel as branch manager for the New York-New England area, and of Alex M. Oleair as branch manager for the Philadelphia-Baltimore-Washington area are announced by the Nelson Stud Welding Division of Gregory Industries, Inc., Lorain, Ohio.

Mr. Scheel has been field engineer in the New York area for the past six years, while Mr. Oleair has been field engineer in the Philadelphia region for the past 4 years.

Ray M. Lucas, field engineer in the Denver area, has been named branch manager and assigned additional responsibility for distributor relations in the Rocky Mountain states.

Karp & Lesser Form New Company

Daniel S. Karp and John Lesser, formerly chief executive officers of Karp Metal Products Co., Brooklyn, announce the formation of Karp, Lesser & Co., Inc., serving as engineering and management consultants to the precision sheet metal fabrication field and allied industries. The new firm's offices are located at 60 E. 42nd St., New York 17, N. Y.

Mr. Lesser is a member of the AMERICAN WELDING SOCIETY.

INTERNATIONAL WELDING NEWS

IIW Commission VIII—Hygiene and Safety

By H. F. Reinhard

Commission VIII—Hygiene and Safety, of the International Institute of Welding, has as its objective the determination of true facts with regard to health, safety and fire hazards in welding and allied processes, and the development of recommendations on principles and methods of protection.

Hazards that Commission VIII has studied to date include:

- Welding fumes—metals welded upon
- Welding fumes—fluxes and metal coatings
- Nitric oxides
- Hazards in the use of radioactive isotopes, i.e., cobalt 60
- Eye protection
- Electric shock hazards
- Inert-gas-shielded arc welding—special hazards

The experience and thinking of the American welding industry on the above subjects has been supplied in detail to the members of Commission VIII and it is interesting and pleasing to note that the Commission's conclusions are in agreement in all essential points.

Currently being developed is a handbook on "Safety in Electric and Gas Welding and Cutting Operations." A first draft of the handbook has been prepared and was discussed in some detail at the meeting of IIW in Madrid earlier this year. It is a rather voluminous document, consisting of 77 typewritten pages—single spaced. In the preparation of the draft, one of the principal references was American Standard Z49.1 "Safety in Electric and Gas Welding and Cutting Operations," developed under American Standards Associations Sectional Committee Procedure with the American Welding Society as the sponsor body. Much work must still be done in preparing the American industry's comments on this proposed IIW handbook. It is anticipated that the help of the members of the AWS Committee on Safety Recommendations will be solicited.

A number of other items are under consideration by Commission VIII but work on them has not progressed sufficiently to permit any comment in this report.

The American welding industry has, from its beginning, deemed it important to develop and disseminate authoritative information on such hazards as may exist in connection with its products and their use. It is important that people not be injured or property destroyed. In addition, erroneous information often leads to unwarranted restrictions.

Since information on hazards in welding is being developed at an international level, we should contribute our know-how. It will all add up to increased safety with attendant moral and financial advantages to the welding industry in all countries.

H. F. Reinhard is the official American delegate on Commission VIII of the International Institute of Welding.

Harnischfeger Forms Chilean Company

A complete line of welding electrodes are now manufactured in Santiago, Chile, by a new company being formed with joint ownership by A. Montero y Cia. S. A. and Harnischfeger International Corp. The new firm has been licensed by Harnischfeger Export Corp.

A completely new factory was erected for the manufacture of the P&H electrode line. All chemicals for electrode manufacture are purchased direct from P&H.

Distribution of the Chilean produced electrodes will be made through P&H electrode distributors in other Latin American countries.

Rotary-Disk Contactor

The largest ever built, this 60-in. rotary-disk contactor for an oil refining process will stand over 60 ft tall when completed. Inside the vessel will whirl shaft-mounted disks which match the concentric rings welded to the shell.

The variable-speed rotor operates at from 65 to 200 rpm and must be statically and dynamically balanced so that total indicated runout does not exceed 0.032 in.

The contactor, of all-welded construction, is being built by Baldwin-Lima-Hamilton Corp., under contract with C. F. Braun & Co. for the Tidewater Oil Co. After welding is completed, the structure will be stress relieved at 1100° F.

Resistance Welding Equipment Activity Remains High

The regular statistical reports of the Resistance Welder Manufacturers' Association during 1956 have continually shown tremendous increases in both new business and shipments. The August compilation is no exception in this picture of continuous high level of activity.

Two new shipment records were attained in August. The month represented a new peak for a single thirty-day period, with nearly $6^1/_2$ million in machines shipped.

In addition, shipments for the first 8 months of 1956, $33 million, represent more than all of the dollar volume recorded in 1955. At this point in the year, equipment shipped stands 69% ahead of 1955.

As for new orders received, more than 85 million were placed on the books of members during August. This is the 4th month this year that this high figure in new business has been reached. Thirty-

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You get an overlay with remarkably long life in severe metal-to-metal wear applications, when you use Ampco-Trode electrodes. They are available in a wide range of deposit hardnesses resistant to all forms of wear — sliding wear, erosion, cavitation-pitting, and corrosion.

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Add extra life to bearings, bushings, sheaves, gears, pinions and many other parts. Stock all five grades of Ampco-Trode electrodes and have a variety of deposit hardnesses on hand.

Ampco-Trode Grades	Electrodes & Filler Rod	Deposit Hardness Metallic-Carbon-Arc	Deposit Hardness Inert-Gas
	Ampco-Trode 10	130-150	160-190
	Ampco-Trode 160	150-170	190-220
	Ampco-Trode 200	180-220	250-280
	Ampco-Trode 250	230-270	310-340
	Ampco-Trode 300	280-310	350-380

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seven million dollars in new equipment orders, or 70% more than last year, has been written during the first 8 months of 1956.

Manufacturing Division Formed by Wall Colmonoy

Formation of the Wallco Manufacturing Division of Wall Colmonoy Corp., Detroit, has been announced recently. Formerly known as the Furnace Brazing Division, Wallco has facilities for design, development and manufacture of brazed assemblies involving tubular, stamped and machined components.

Named general manager of the new division is Frank R. Reynolds, a vice-president of the corporation since 1955.

Welding and Cutting Exhibition to Be Held in Germany in 1957

The greatest welding engineering exhibition in Europe, the DVS Exhibition "Welding and Cutting" will take place from June 23 to July 3, 1957, on the exhibition site at Essen. This exhibition will be larger and more important than those of 1952 and 1954. It will be launched under the heading of "Welding in Production and Application."

The development and the present position of welding will be shown as well as the trend of future research. Within the framework of the exhibition, manufacturers of welding plant and equipment will show the latest developments and performances of their products. Practical demonstrations of such new plant and equipment and of welding and testing procedures having special interest will give opportunities for examination and comparison and create new ideas in the minds of the visiting experts from home and abroad.

An extensive display by users of welding equipment will add greatly to the interest of the exhibition. The application of welded construction and the use of materials with higher mechanical properties results in more efficient designs and reduced manufacturing cost. This has been appreciated by industry and in consequence welding is being applied to an ever growing extent. The 1957 exhibition will give prominence to the possibilities of welding applications.

The expert engineer and the man more interested in the commercial side will thus find a systematic and clear picture of industrial practice.

Together with the Exhibition, from June 25th to 28th there will be the Great Congress of Welding Technique of the German Association of Welding Technique which in its lectures, will deal with the "Improvement of Efficiency and Productivity through the Welding Technique." From June 29th to July

WINNERS OF ANNUAL FARM WELDING AWARDS

The three young winners of the Arizona State FFA Farm Welding Contest are shown with Steve Meehan, Phoenix Welding Supply Co., who presented the awards. Gail Deal, Phoenix, who won third place, is at left; Marion Brown, Roll, first place winner. Mr. Meehan; and Gene Patterson, Tolleson, second place winner.

6th the International Institute of Welding will hold its annual congress in Essen, which will be in conjunction with a series of lectures "Metallurgy of Welding" and with sessions of the various working committees.

Win Farm Welding Contest

Marion Brown, a member of the Antelope FFA Chapter, received a new Hobart 180-amp arc welder as first place winner in the Farm Welding Contest sponsored by the Phoenix Welding Supply Co.

The contest was based on the student's understanding of farm machinery, design, repair and a piece of farm equipment built by the contestant, utilizing welding in its construction.

Second place winner was Gene Patterson, Tolleson future farmer who received a Smith combination welding outfit including Dye oxyacetylene tanks. Third place went to Gail Deal of Phoenix Union who won a Stoody hardfacing jig and up to $100 value in hardsurfacing welding rod.

This annual contest is put on to promote welding in the schools and on the farms in the state of Arizona. It has done much to bring a better knowledge of welding to the people of the state.

Connector Distributorship to G.E.

The General Electric Co.'s Welding Department, York, Pa., has been appointed a national distributor for the Cam-lok neoprene insulated cable connector, according to a recent announcement.

The new device will be sold through General Electric's national network of welding distributors and direct sales offices. It is a product of the Cam-lok Division of Empire Products, Inc., Cincinnati, Ohio.

The Cam-lok connection method consists of crimping two brass connectors to the cable ends, drawing each connector into a neoprene sleeve, and then vulcanizing each sleeve directly to the cable insulation. When the connectors are joined a shockproof, waterproof joint is reportedly produced, with a lock that can be taken apart instantly.

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PERSONNEL

Hart Joins Valley Welding

Robert A. Hart has been appointed secretary-treasurer and general manager of Valley Welding Supply, Inc.

Mr. Hart is a graduate of the University of Wisconsin in business administration; has held responsible sales management positions with a large automobile manufacturer; and has had practical experience in the welding field.

Valley Welding Supply's continued expansion has resulted in the following realignment of the functions of the officers of the company: William T. Hart, president and directly responsible for purchasing, stores, and trucking; Edwin L. Hart, vice-president and sales manager; and Robert A. Hart, secretary-treasurer and general manager.

Coyne Made Director of Australian Firm

Michael F. Coyne, president, California Oxygen Co., San Francisco, California, has been made director in the four-million dollar Pacific Oxygen Co., Ltd., of Melbourne, Australia.

The company, formed July 11th, will manufacture oxygen, acetylene and other industrial and medical gases, as well as a full range of accessories for oxygen-acetylene and allied processes to be sold on an Australian-wide basis.

Goldsmith Honored

Lester M. Goldsmith has been honored by The Atlantic Refining Co. for the completion of forty years of service with the Company. He is general manager of the Company's Engineering and Construction Department.

Dr. Goldsmith is well-known for his many engineering contributions to the advancement of the petroleum industry. He successfully pioneered the application of electric welding in the construction of pipe lines and ocean-going tankers. He engineered the development of the first high-pressure, high-temperature, turbine electric steamship and was later responsible for the world's first class of 3,000 deadweight ton supertankers used in the oil industry.

During World War II he served as an expert consultant to the War Department. For his services, he received the U. S. Army Exceptional Civilian Service Medal and the Presidential Certificate of Merit. Dr. Goldsmith is a member of the AMERICAN WELDING SOCIETY.

Strother Named Regional Manager

John Strother of Concord, Tenn., is now serving as regional manager for All-State Welding Alloys Co., Inc., in seven of the East South Central and South Atlantic States (Ga., N. C., Tenn., Ky., Va. and W. Va.).

John Strother

Mr. Strother is responsible for sales and service to the users and distributors of All-State alloys and fluxes in his area. He will be the contact man for All-State's metallurgical resources and experimental laboratory.

Mr. Strother received a C.E. degree from Poncelot Institute of Technology, Charlotte, N. C., in 1936.

Mayor Joins Thornton

Effective Sept. 1, 1956, William Mayor joined the Thornton Co. of Cleveland, Ohio, as an estimator and assistant to Frank Flocke, vice-president in charge of engineering and sales. The Thornton Co. is one of Cleveland's prominent steel and alloy fabricators of chemical processing and general industrial equipment.

Mr. Mayor has been associated with the welding field since 1935. He started as a welder, then advanced to welding supervisor and for the past 10 years, has been in the Estimating Department of the Lewis Welding & Engineering Corp. of Bedford, Ohio. During the last 4 years he has served as supervisor

William Mayor

of the estimating and processing department.

He has been an active member of the AMERICAN WELDING SOCIETY since 1938, a Board Member of the Cleveland Section since 1954, and is currently the first vice-chairman.

Bailey Promoted by Harris Calorific

Dana H. Bailey has been named director of new Products and Process Development by the Harris Calorific Co., Cleveland, Ohio, manufacturers of gas welding and cutting equipment.

A native of Wisconsin, Mr. Bailey is a graduate of the University of Minnesota. Following 5 years as an associate professor at Pennsylvania State College, he joined the Pfaudler Co. of Rochester, N. Y., as an experimental engineer.

Dana H. Bailey

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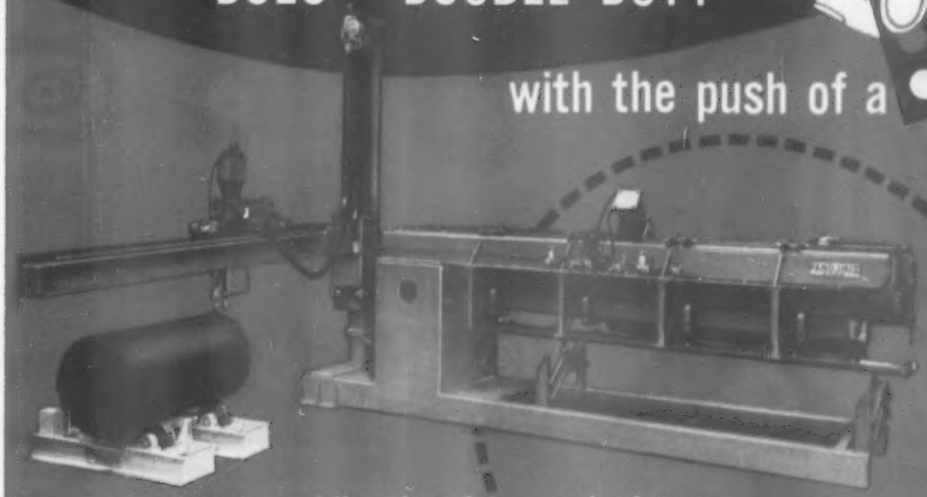

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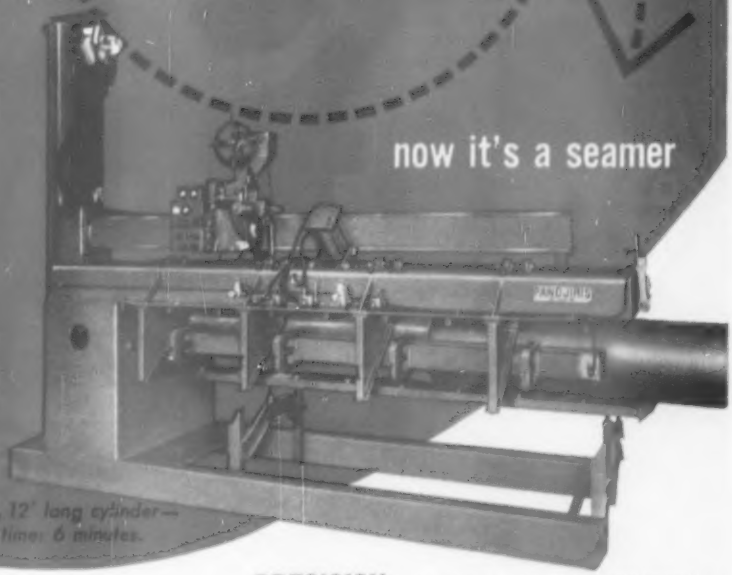

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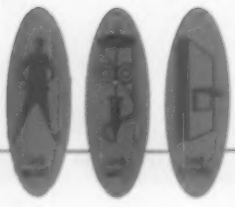

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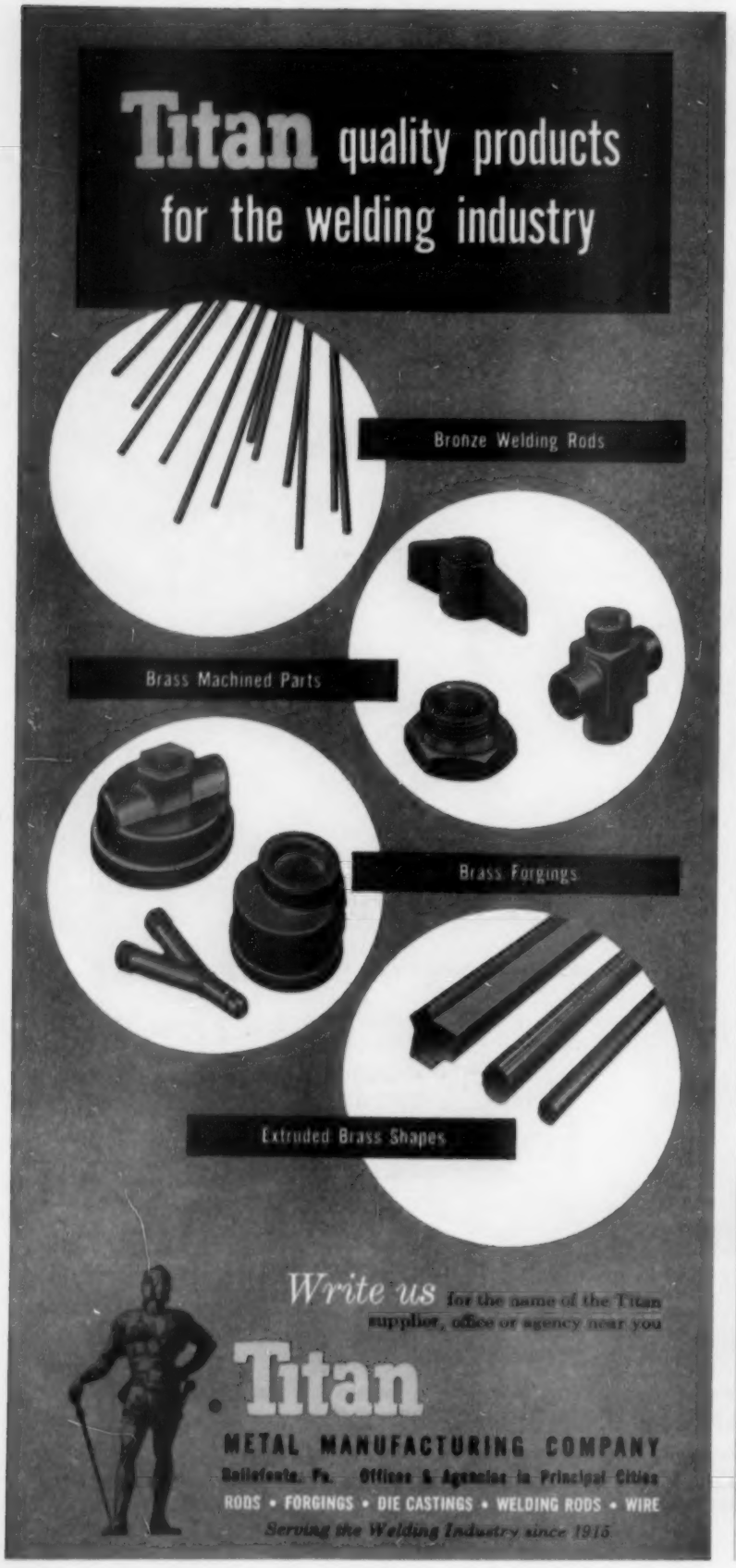
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Two years later he became chief design engineer for the John R. R. Miles Welding Equipment Co. in Minneapolis, Minn., and then, chief engineer for the Sta Rite Products Co., Delavan, Wis., manufacturers of motor pumps and systems.

Mr. Bailey came to Harris Calorific in 1945 as a project engineer.

ELECTED TREASURER

David H. Lyall has been elected treasurer of Air Reduction Co., Inc., succeeding Howard H. Foster who has resigned. Mr. Lyall, with the company for 21 years, became general auditor in 1944 and has been assistant controller since 1949.

Lamont Appointed by Reid-Avery

The Reid-Avery Co. announces the appointment of Wm. Lamont as the direct sales representative in the Buffalo area. Mr. Lamont will cover the area consisting of western New York State and Ontario, Canada.

Previous to his association with the Reid-Avery Co., Mr. Lamont was the sales manager of Liquid Carbonic Corp. in the Buffalo area and president of De-

Wm. Lamont

troit Industrial Welding Co. of Detroit, Mich.

Mr. Lamont, has also been associated with Bird Gas Co. and National Cylinder Gas Co. of Detroit, Mich., and has had wide experience in various welding applications.

Nippes Wins Teaching Award

Ernest F. Nippes, Professor of Metallurgy, Rensselaer Polytechnic Institute, Troy, N. Y., is the winner of the 1956 $2000 Teaching Award, sponsored by the American Society for Metals.

Selection of Dr. Nippes was made by

Ernest F. Nippes

a special awards committee named by the Board of Trustees of ASM.

Dr. Nippes is a native New Yorker. He received his B.S. degree, his master's degree and his Ph.D. degree from Rensselaer.

He has been a member of the metallurgical engineering faculty of Rensselaer since 1938, first as an instructor in metallurgy, later as assistant professor and in 1954 as a full professor.

Dr. Nippes is the author or coauthor of numerous articles on welding. He is a member of eight technical societies, including the AMERICAN WELDING SOCIETY.

Waldron Promoted by Miller Electric

The Miller Electric Manufacturing Co. of Appleton, Wis., manufacturers of arc and spot welders, today announced the appointment of J. G. Waldron as advertising manager. Mr. Waldron has been with Miller for the past 3 years as sales correspondent and managing editor of their 7000-circulation house organ, *Memco News*. He

J. G. Waldron

will continue to act as editor of this publication in addition to his new duties. An overseas veteran of World War II, Mr. Waldron brings well-rounded and diversified experience in the fields of teaching, personnel placement counseling, selling and writing to his new position. A University of Wisconsin journalism major, Waldron has had stories published by *Collier's*, *American Magazine* and *Bluebook*. He is a native of Oconto Falls, Wis.

OBITUARY

John Caluwaert

John Caluwaert, vice-president, Industrial Air Products Co., passed away in New Orleans Monday evening, September 24th.

Mr. Caluwaert had been active in the welding industry during the great majority of his business life and during this period acquired a number of friends who will sorely mourn his passing.

Services took place at St. Edmund's Church, Oak Park, Ill., Saturday morning, September 29th.

INSTRUCTIONS FOR PROSPECTIVE AUTHORS

Authors who plan to submit papers for publication in THE WELDING JOURNAL are invited to send for a free copy of the booklet "Instructions and Suggestions for Authors." All requests should be addressed to Editor, THE WELDING JOURNAL, American Welding Society, 33 W. 39th St., New York 18, N. Y.

AIRCO

WELDING and BRAZING Hints

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SOLUTION:

Airco #22 Manganese Bronze Rod. A general purpose rod that should be in every welding shop where high strength brazed joints are required. Flows smoothly and produces sound joints on maintenance work when used with either Airco Marvel Flux or Airco High Test Liquid Flux. Airco #22 is also available with flux already coated on the rod to insure positive base metal protection.

Airco #20 Bronze Rod. Ideal for braze welding of steel, cast iron, malleable iron, copper, and dissimilar combinations of these metals. Airco #20 is available as a pre-coated rod using Hi-Test Flux. When this rod is purchased bare, either Hi-Test or Marvel Flux can be used for high strength welded joints.

Airco #27 Low Fuming Bronze Rod. For the brazing or braze welding of steel, cast iron, or bronze. Low fuming characteristics of this rod increase its applications in restricted areas. Recommended fluxes for use with Airco #27 are Airco Hi-Test or Marvel Flux. Flux coated rods also available.

Brazing and Braze Welding Flux. A good brazing flux cleans the joint, removes oxides created by heating, and picks up impurities in filler metal. Airco Hi-Test Flux, when properly applied, will accomplish these jobs.

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NEW LITERATURE

Metallizing Bibliography Released by the American Welding Society

To many people the metallizing process is new or even unexplored. However, the extent of its use in the past is indicated by the Metallizing Bibliography just published by the AMERICAN WELDING SOCIETY. This is considered to be the most complete bibliography on metallizing ever to be published. It contains 181 articles which have been published since 1913, each with annotation describing the contents.

The items are grouped together under the headings: equipment, processes, applications, testing, theory, costs and miscellaneous. Thus it will serve as a reference to anyone interested in any phase of metallizing. The 68 publications in which these articles appeared are listed with their addresses so that copies of articles which are of interest may be obtained from the publishers.

Copies of the Metallizing Bibliography can be purchased at $1.50 per copy from the AMERICAN WELDING SOCIETY, 33 W. 39th St., New York 18, N. Y.

Fundamentals of Brazing

A report of research for the Army, bearing on fundamental problems of brazing, has been released for industry use through the Office of Technical Services, U. S. Department of Commerce:

Fundamentals of Brazing. N. Bredzs and O. T. Barnett, Armour Research Foundation for Frankford Arsenal, U. S. Army. 162 pages. $4.25. (Order PB 111697 from OTS, U. S. Department of Commerce, Washington 25.) This final report of research between June 1953 and June 1954, the second year of a continuing project, describes two fundamental investigations. The first concerned causes and elimination of imperfections in brazed joints, with specific study of the wettability phenomenon and the mechanism involved. Among other results, a new phenomenon was observed which demonstrated the influence of oxygen through layers of molten pure and alloy-based silver on the wettability of steel surfaces. Subsequent tests indicated new possibilities for development of self-fluxing, air-proof brazing alloys. The second study dealt with tensile-strength-joint thickness curves for pure silver and pure copper brazed in SAE 1020 steel and drill rod. During experiments with silver, it was indicated that in extremely thin joints the fracture strength of the filler metal can enter the region of brittle fracture. Investigation of extremely thin copper brazed joints led to development of a new brazing method characterized by complete diffusion of the filler metal into adjacent layers of the base metal.

Liquid Rosin Flux

A new 2-page technical bulletin giving a complete description, uses, properties and methods of application of Alpha Metals' Inc. No. 100 liquid rosin flux (nonactivated), is now available. A helpful graph showing the concentration density relationship of No. 100 flux and Alpha's No. 400 flux thinner is included in the bulletin.

This information will be of particular interest to those involved in the problems of electrical, electronic and printed circuit soldering.

Write for bulletin No. 1, Alpha Metals, Inc., 56 Water St., Jersey City, N. J.

Resistance Welding

Sciaky Bros., Inc., 4915 W. 67th St., Chicago, Ill., introduces Vol. 4, No. 7 "Resistance Welding at Work," covering the use of Sciaky resistance welding techniques to fabricate miter joint aluminum window frames at the Reynolds Metals Fabricating Division, Louisville, Ky.

Other sections of this bulletin illustrate and describe a sequence of operation with this new fastening technique. Also discussed are material specifications, machine settings, destruction testing, etc.

For a more complete description of resistance welding aluminum miter joints at Reynolds, write direct to Department L-12 at the Chicago address for your free copy of Vol. 4, No. 7.

Process Manual

A new manual—52 pp., 4 x 7 in.—has just been published by All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N.Y. Its scope is all methods of metal joinery usual to the welding shop plus cutting without oxygen. It covers work on aluminum and aluminum alloys (including joining aluminum to dissimilar metals), cast iron, copper and copper-bearing alloys, magnesium, Monel, nickel, stainless steel, steel and zinc-base die cast.

Single copies are available to operators . . . up to five copies to supply welder crews or training groups are available when requested by any company or instructor . . . without charge or obligation. Additional copies may be obtained for 10¢ each. Requests should be directed to the company or to any All-State distributor.

Ampco Welding News

The Third Quarter Issue of the *Ampco Welding News*, which is published by the Weldrod Department of Ampco Metal, Inc., presents several articles regarding specific products and their application.

The feature article describes the role played by Ampco-Trode 200 overlays and Ampco 16 bearings in the operation of the Cheatham Dam gates. Other articles describe the use of Ampco-Trode 10 spooled wire for fabricating Minesweeper manganese bronze hawse pipes; the fabrication of expanding dies for sizing tanks; how drop hammer columns were rebuilt with Ampco-Trode 250; etc.

Free copies of this publication may be obtained by writing to Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 46, Wis.

Low-Alloy Welds

The International Nickel Co. announces the availability of the 7-page, illustrated article entitled: "Some Dynamic Mechanical Properties of Heat-Treated Low-Alloy Weld Deposits."

Weld deposits of nickel-molybdenum-vanadium steel (AWS E10015-16) were

studied and found to have excellent ductility, and exceptional endurance limits under cycles of reversed stress. Subject includes the as-welded, stress-relieved, annealed, and quenched and tempered conditions. Applicable where fatigue properties are important.

For your copy, write to Reader Service Section, The International Nickel Co., Inc., New York 5, N. Y.

Surfacing Brochure

Effectiveness of hard surfacing in extending the life of equipment continually subjected to wear and impact in cement and aggregate plants is told in a brochure published recently by Rankin Manufacturing Co., Alhambra, Calif., makers of "Ranite" hard surfacing welding materials.

The brochure, "Cement and Aggregate Plants Profit by Hardsurfacing," presents case studies of hard surfacing uses and contains photographs of actual applications. Examples shown include a gyratory crusher mantle, crusher rollers, mill hammers, screw flights and others.

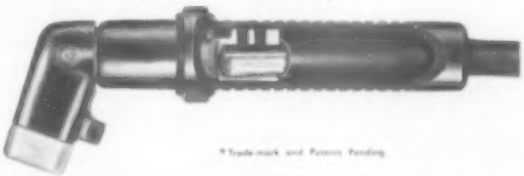
Rankin's hard surfacing for cement and aggregate plant brochure, Form 1500, may be obtained from welding supply distributors and their salesmen or from the factory: Rankin Manufacturing Co., Dept. R-2, 616 S. Marengo Ave., Alhambra, Calif.

The fraying of welding cable at the area where the cable connects to electrode holders has existed since the day arc-welding first began, and has wasted more man hours, more welding cable, and has necessitated more maintainance, than any other known factor.

"CABLE-SPLINT" completely, efficiently, and inexpensively solves the fraying problem by supporting the cable where it is stripped of its natural supporting jacket.

Driven down between the core wires and the jacket of the cable by light hammer blows the "CABLE-SPLINT" becomes a third member of the cable.

By this new method it is the natural resilience of the cable jacket which tightly binds the supporting "CABLE-SPLINT" to the core wires and solidly anchors it to the jacket.



*Trade-mark and Patents Pending

"CABLE-SPLINT" is another exclusive feature of the "SHORTSTUB" Electrode Holder. The reinforced cable end may be either clamped or soldered to the "SHORTSTUB" according to common practice. Contact your local distributor or write direct for full information.

BERNARD WELDING EQUIPMENT CO.
10232 S. Avenue 'N' · Chicago 17, Illinois

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Grinding Wheels

A bulletin just released by American Emery Wheel Works, Providence, R. I., illustrates and describes the company's new break-resistant Duraflex reinforced grinding wheels.

These new wheels, heavily reinforced with strong fabric, bonded with resins, are made with a depressed center and, according to manufacturer, are intended particularly for rough grinding, reducing heavy welds, undercutting and notching. In foundries, the new wheel is very handy for cutting off gates and risers and cleaning castings.

The manufacturer will be pleased to supply copies of the Duraflex bulletin upon request. Write to the above address.

Aluminum Color Code Chart

A handy chart identifying the Aluminum Association color codes for aluminum rod, bar and wire alloys has been published by Kaiser Aluminum & Chemical Sales, Inc.

Of special interest to fabricators, the chart lists 32 alloys and their respective color codes which were recently adopted by the Aluminum Association for use throughout the country. It also depicts Kaiser Aluminum color coding for identification tags on wire alloys.

The "Rod, Bar & Wire Color Chart" is designed as a quick reference wall chart or for insertion in a three-ring binder. It is available upon request to Kaiser Aluminum & Chemical Corp., Consumer Service Division, Room 1156, 1924 Broadway, Oakland 12, Calif.

Oxidation-Resistant Brazing Alloys

Bulletin 30, consisting of 13 pages, summarizes a large series of investigations made at the Handy and Harman Research Laboratory under the Direction of George H. Sistare and Allen S. McDonald covering high-temperature brazing alloys. This publication is one of the regular series of the Welding Research Council.

Single copies may be obtained at a dollar from the American Welding Society, 33 W. 39th St., New York 18, N. Y.

Quantity lots of 15 or more may be purchased from the Welding Research Council, 29 W. 39th St., New York 18, N. Y.

NEW PRODUCTS

Noncorrosive Solder Fluxes

Noncorrosive, quick-wetting solder fluxes designed primarily for use on copper and copper base alloys are now being manufactured by Federated Metals Division of American Smelting and Refining Co. These new fluxes utilize safe-to-handle derivatives of the war-born chemical, hydrazine, and are

known as Federated H-Series solder fluxes.

According to manufacturer, the H-Series fluxes promote solder spread over a wide range of temperatures more effectively than conventional zinc-ammonium chloride fluxes, reducing oxides to free metal as the temperature of the work is raised above 375° F. During the soldering operation the flux decomposes and vaporizes, leaving essentially no residue.

For additional information regarding the use or supply of these new fluxes write to Solder Flux Sales, Federated Metals Division, American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.

Bronze Welding Rods

Air Reduction Sales Co. has announced three new extruded, heavy coated bronze oxyacetylene welding rods, especially designed for braze welding and welding malleable iron, cast iron, brass and bronze with dirty, oily or greasy surfaces. Three types are available: Airco No. 20 bronze rod for general braze welding and welding; Airco No. 22 manganese bronze rod for high strength welds; and Airco No. 27 low-fuming bronze rod.

These new extruded rods are made in four diameters—1/4 in., 5/16 in., 1/4 in. (36 in. long) and 3/32 in. (18 in. long).

Airco 20, 22, and 27 are also available with a dipped coating for clean production work.

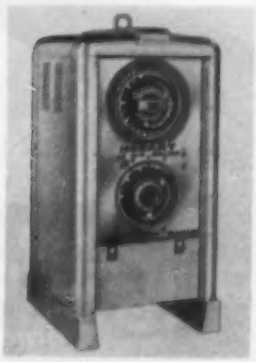
Additional information may be obtained by writing Air Reduction Sales Co., a division of Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N. Y.

New A-C D-C Arc Welder

Hobart Brothers Co. announces the introduction of an a-c d-c and inert-gas arc welder.

The welder is rated 200 amp, 40 volts and has a current range of 10 to 300 amp, ac or dc.

Features include new case with easily



removable side panels, recessed control panel and selector switch which permits operator to choose a-c, d-c straight, or d-c reverse welding current. It also has a magnetic contactor and removable rheostat for remote control at no extra cost.

For more information write Hobart Brothers Co., Troy, Ohio.

Iron-Powder Electrode

A new iron-powder electrode, Speedex Type U, for welding mild and galvanized steels, has just been introduced by Metal & Thermit Corp., New York.

Designated AWS Type 6013 electrode, the new product is the fourth formulation in the firm's Speedex Series. It is recommended particularly for structural welding, shipbuilding, tank fabrication and general maintenance.

Speedex Type U electrode is suitable for use in all welding positions on any type of current at high amperages.

Other electrodes in the Speedex series are Speedex, Speedex LH and Speedex HTS.

For complete information, write directly to manufacturer at above address.

X-Ray Units

Four new portable industrial x-ray units for the radiographic inspection of castings, welds and assemblies have recently been announced by Mitchell Radiation Products Corp., at Norristown, Pa. Three of the units, Models

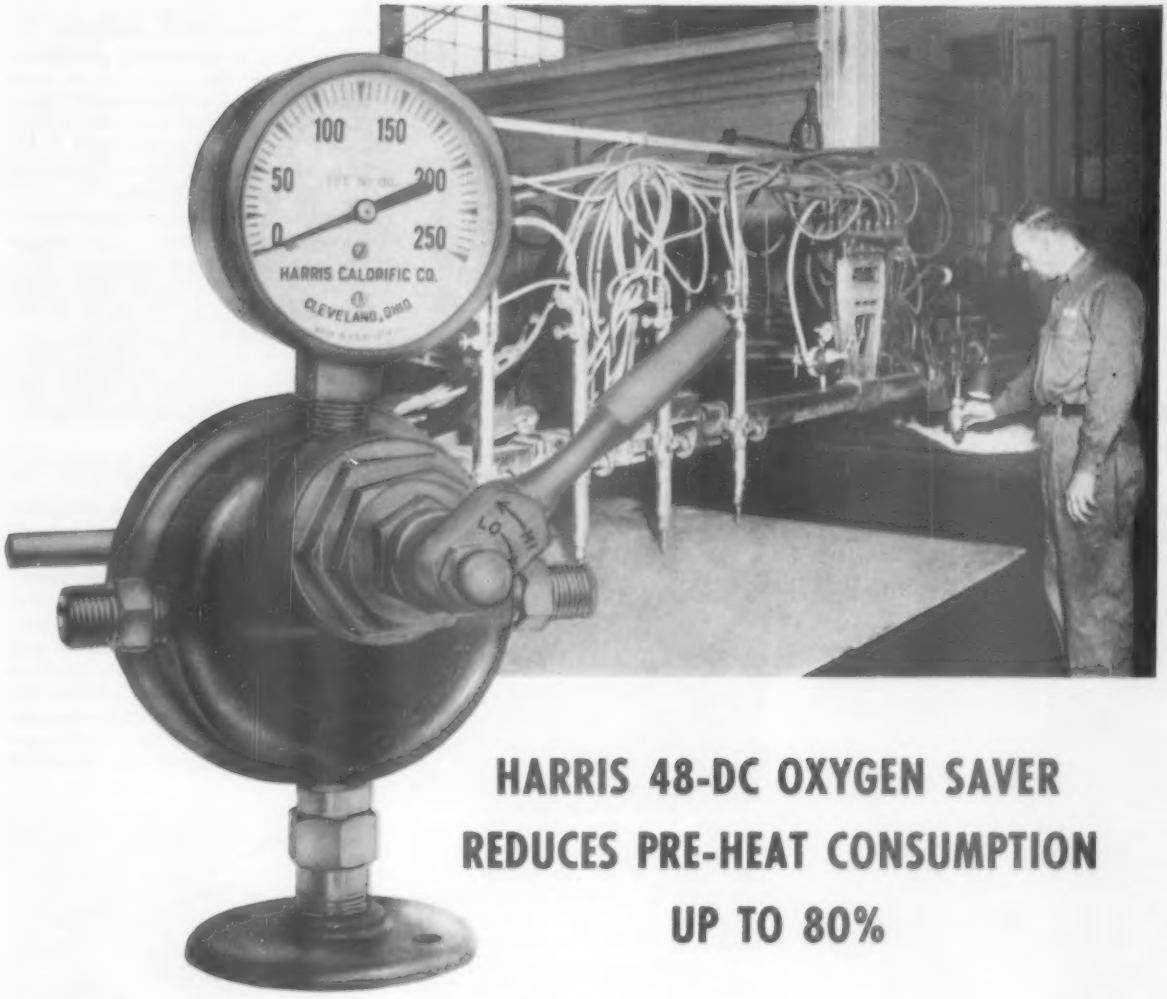
MS-200, MS-260 and MS-300 are designed specifically for heavy duty work while the fourth unit, Model MS-140, is a smaller trepanning unit for spot examination of welds and light radiography.

Write Mitchell Radiation Products Corp., 128 E. Washington St., Norristown, Pa., for complete technical data and application information.

Engine-Driven Welders

The Lincoln Electric Co. of Cleveland, Ohio, announces that stellite-faced, rotating valves are now standard equipment on all of its air-cooled, engine-driven welders. These 180- and 250-amp welders are powered by engines manufactured by the Wisconsin Motor Corp. of Milwaukee, Wis.

Lincoln expects that the new type valves will triple valve life, resulting in higher efficiency output from the welding generator. Valve-wearing surfaces are faced with stellite and then, in operation, are rotated approximately 8 deg on every stroke of the engine to insure even wearing.



HARRIS 48-DC OXYGEN SAVER REDUCES PRE-HEAT CONSUMPTION UP TO 80%

It takes just a flick of a wrist. You can now control pre-heat oxygen pressures to as many as eight machine cutting torches simultaneously! Working from your regular operating position, and using the new Harris 48-DC Oxygen Saver, you get unbelievably smooth, fast cutting results.

You get faster starting, piercing and cutting than ever before with the Harris unit. Independent control of the starting flame enables you to vary one without affecting the other.

✓	Up to 50% faster cutting speeds over older methods.
✓	Up to 80% reduction in consumption of pre-heat oxygen. Overall oxygen consumed lowered 20%.
✓	Slag removal reduced to a minimum.

Write us for further details on this remarkable Harris unit, or call your nearest distributor.

HARRIS

HARRIS CALORIFIC CO.

5500 CASS AVE. • CLEVELAND 2, OHIO

Cutting Tips

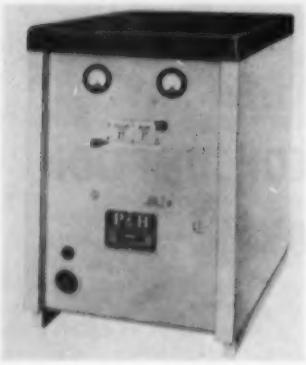
A new series of six preheat cutting tips have been developed by The K-G Equipment Co., Inc., Allentown, Pa. The tips, named the "M-6 Series," are six-holed, swaged tips which, according to manufacturer, give extremely fine flame characteristics, much faster preheat, narrow kerf, and a very small amount of slag when adjusted to neutral. They have been field tested and are now available in sizes 00 to 10.

For complete details, write directly to The K-G Equipment Co., 1774 Lehigh St., Allentown, Pa.

Modified Constant-Voltage Welder

Harnischfeger Corp.'s Welding Division at Milwaukee, Wis., has announced a new line of modified constant-voltage welders that permit better and fuller control over a wide range of applications. The line consists of 300-, 500-, 750- and 12000-amp machines.

According to manufacturer, the main



feature of the new P&H modified constant-voltage machines is an adjustable slope control that gives a softer arc, eliminates burn-back and stubbing, and provides a stable, spray-type deposit when properly adjusted for aluminum, stainless steel and other alloys.

Additional information on P&H modified constant voltage welders is available from the Harnischfeger Corp., Welding Division, Milwaukee 1, Wis.

Wire for CO_2 Welding

A mild steel copper-flashed welding wire is now available from the Westinghouse Electric Corp. Developed primarily for use with CO_2 shielding gas, Type MS-21 wire has a controlled analysis and may also be used for inert-gas welding.

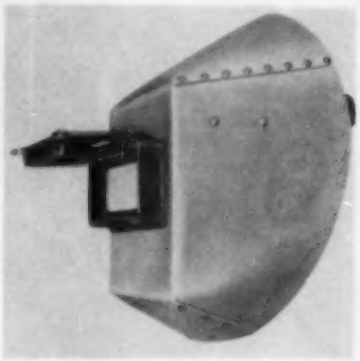
The wire is available in four diameters; 0.040, 0.0625, 0.077 and 0.091 in. It may be purchased on 25-lb disposable spools or 400-lb "payoff-pak" barrels.

For further information on Type MS-21 and other welding wires and electrodes, write Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

Welding Helmet

A new, narrow, deep design welding helmet with lift-front lens holder is announced by The Fibre-Metal Products Co. for easy access to work in close quarters.

Designated No. 668–9, the helmet is light in weight and has the No. 1176



"Dowmetal" Lift-Front glass holder which is insulated on the inside of the helmet. It is equipped with a wide range ratchet adjustment to fit all head sizes; it has two positive stops, two position joints to equalize movement, and is equipped with a padded sweatband for complete comfort.

Full information may be obtained by writing the manufacturer, The Fibre-Metal Products Co., Chester, Pa. Bulletin No. 47 describes this welding helmet.

Liquid Oxygen Cylinder

The Linde Air Products Co., New York, has announced the introduction of the new LC-3, liquid oxygen cylinder.

The LC-3 is described as being an entirely new type of cylinder, and is said to be a compact, easily operated container capable of producing a large volume of oxygen at any use point.

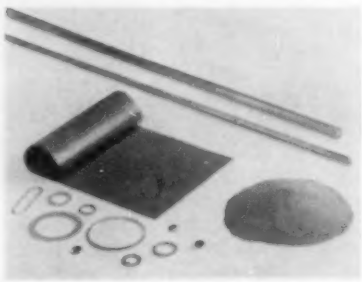
The LC-3 has a capacity of 3000 cu ft of oxygen—the equivalent of more than 12 "K" type high-pressure cylinders. At the same time, the LC-3's weight when full is only 505 lb—a little more than $\frac{1}{4}$ the weight of its equivalent in "K" cylinders.

According to the manufacturer, this combination of relatively light weight and large capacity makes the new LC-3 ideal for use wherever more than 5000 cu ft of cylinder oxygen per month is consumed at any one use point.

For complete details write to Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

High-Nickel Brazing Alloys

Handy & Harman announces a series of four high-nickel content brazing alloys for high-temperature and corrosion-resistant service. These alloys, called Handy Hi-Temp alloys, offer high strength at elevated temperatures, superior resistance to corrosion and oxidation, according to manufacturer. The alloys are intended particularly for brazing austenitic stainless steel, high-nickel heat-resistant and precipitation-hardening alloys. They will



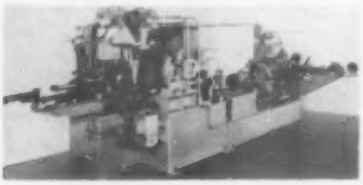
also braze carbon steel and nonferrous metals having melting points above 1850° F.

The four high-nickel alloys have nickel contents ranging from 72.5 to 93.25%, silicon between 3.50 and 5.00%, and boron between 1.90 and 3.50%. Their designations as Handy Hi-Temp 93, 91, 82 and 72 are based on their approximate nickel content. The alloys numbered 82 and 72 have in addition a chromium content of 7.00 and 15.00%, respectively. All the alloys are available as cast rod, powder, resin-bonded sheet, as well as in forms fabricated and sintered from the powder.

Further information about the Handy Hi-Temp high-nickel brazing alloys can be obtained from Handy & Harman, 82 Fulton St., New York 38, N. Y. In Canada, inquiries should be directed to Handy & Harman of Canada, Ltd., 141 John St., Toronto.

Automated Wire-Basket Forming Machine

A new automated machine that performs welding, trimming, cutting and forming operations to produce finished wire-basket assemblies from bulk wire in a continuous operation has been designed and built by Expert Automation



Machine Co., 17144 Mt. Elliott Ave., Detroit 12, Mich.

Longitudinal and cross wires are drawn directly from stationary stock coils into the machine and advanced through various operations by an intermittently operated feed mechanism. The wires are straightened, welded into a continuous strip pattern which is then notched, trimmed and formed into finished basket assemblies by an unusual bending device.

Additional information may be had by writing directly to the company at above address.

Automatic Arc-Welding Equipment

Two new models of West-ing-arc® automatic welding equipment are available from the Westinghouse Electric Corp. for CO_2 gas metal-arc or submerged arc d-c welding.

According to manufacturer, both models are readily used for CO_2 or for

submerged arc operation. Each consists basically of a heavy-duty welding head, control, operator's remote control station, and interconnecting cables. The equipment provides uniform bead contour and crater elimination at high welding speeds. As air-cooled units, they require no cooling water.

Inching of the wire, flux damping, and arc starting are performed automatically with Model SA-40A, and manually with Model SA-40.

The welding head is capable of driving wire diameters from $^{1}/_{64}$ to $^{1}/_{4}$ in. at speeds up to 300 ipm.

For further information, write Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

Aluminum Welding Cable

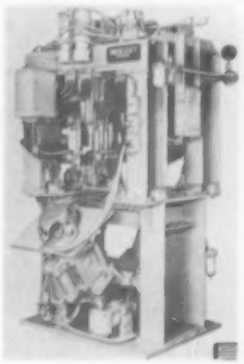
A dramatic demonstration of the more than 50% weight savings of their new aluminum welding cable was provided in a recent air cargo shipment from the Tweco Products Co. plant at Wichita, Kan., to a large East Coast

shipyard. The 3000 ft of size 3/0 cable weighed in on TWA scales at a 1425-lb total, compared with 2900 lb for equivalent copper cable.

For complete information on Tweco-Lite aluminum welding cable, write directly to Tweco Products Co., Boston at Mosley, Wichita, Kan.

Resistance Welders

Sciaky Bros., Inc., 4915 W. 67th St., Chicago, Ill., announce the new design of standard, air-hydraulic operated, single-phase SX multiple spot electrode welding machines for high-production resistance welding applications. A Sciaky standard machine, the SX consists of a universal multiple



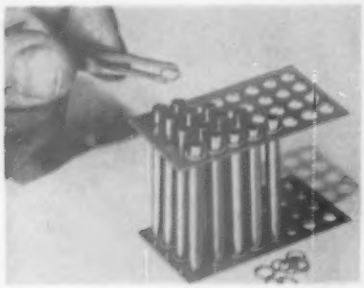
gun base with two separate platen units. The platen units, operating independently, load in extended position, swing-in and lift to the welding position, and after the welding sequence is completed, retract and swing-out for unloading.

The platen lift and retraction feature permits multiple spot welding of deep drawn sections. The swinging in-and-out facilitates loading and unloading.

For complete details, write directly to manufacturer at above address.

Prefabricated Brazing Rings

A new line of prefabricated Nicrobraz brazing rings for use with stainless-steel tubular assemblies of all kinds is now available from the Stainless Processing Division of Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich. Improved

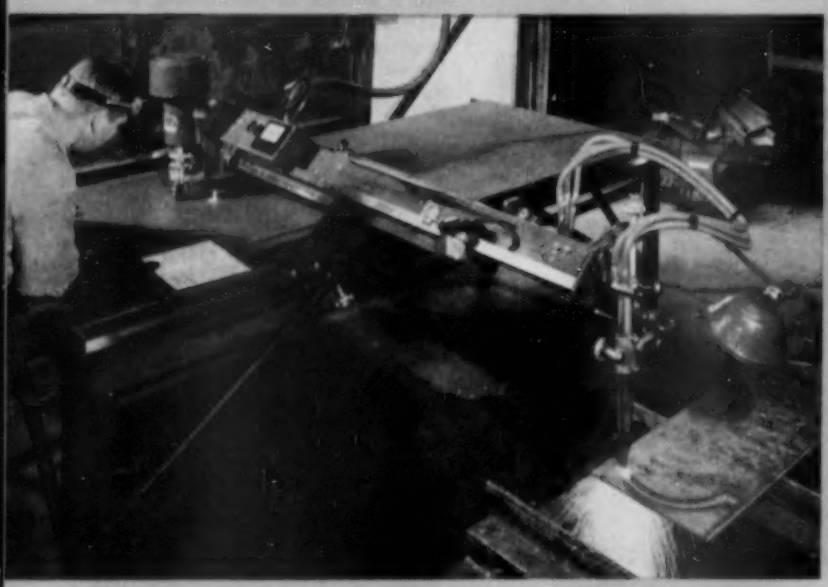


quality in the brazed joint, better finished appearance, elimination of waste and reduced assembly time up to 85% are among the advantages claimed for the Nicrobraz alloy in this new form.

Prefabricated Nicrobraz rings are available in alloy grades to suit any need and can be made for use with all standard or special tube sizes or shapes used in aircraft, air conditioning, automotive, chemical, electrical and other industries.

For complete details write directly to Wall Colmonoy Corp. at above address.

NCG "Type R" automatic cutting machines—3 of them—help speed production at the WHITING CORPORATION, Harvey, Ill., one of the nation's leading producers of foundry and railway equipment, material handling equipment, rotary shears, chemical equipment, and special machinery. Two of the machines, as shown above, are mounted on one long table to provide a 40-foot cutting length. Parts being cut in this picture are for Whiting's "Trackmobile."



MERCURY MANUFACTURING CO., Chicago, uses this NCG "Type JR" stationary cutting machine for close tolerance shape cutting of parts that go into the manufacture of their well known line of "Mercury" fork-lift trucks.

"We'd be lost without our CUT-O-MATIC portable" says Ralph Long of J & L ENGINEERING CO., Chicago. "We use it for everything from beveling heavy plate (above) to cutting strips, circles, arcs and rings in light gauge up to heavy sections."

Bring on ANY flame cutting job!

Do you do large scale cutting ...large in size or large in quantity?

Then the NCG "Type R" is the machine for you. It lets you mount up to 8 torches at once for tremendous output. It cuts shapes up to 10 feet in diameter . . . as small as 1½ inch in diameter. A beveling device can be added for making accurate bevels of all types on plate up to 2½ inches thick. Since the "Type R" is built to order, any of its eight standard forms can be varied if necessary to meet your exact needs—and varied later, too, to meet changing needs. And it will give you long dependable performance: the first "Type R"—installed more than fifteen years ago—is still in service.

Do you need fast, accurate cutting on a medium scale?

If so, it will pay you to get the facts about the NCG "JR" cutting machine. A junior version of the big "Type R," it handles any cutting job you can think of—straight line or shapes, manual or template tracing—on plate up to 3 x 4 feet.

Do you want to mechanize hand cutting operations?

Then ask for a demonstration of the CUT-O-MATIC®—an inexpensive portable cutting machine that weighs just 30 pounds, complete with torch. It cuts circles, arcs, straights, does stack cutting, pipe cutting . . . all with production-line accuracy. An exclusive "floating torch" assembly lets you cut accurate bevels even on wavy plate.

NCG®

NATIONAL CYLINDER GAS COMPANY

840 NORTH MICHIGAN AVENUE, CHICAGO 11, ILLINOIS

Branches and dealers from coast to coast

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NATIONAL CYLINDER GAS COMPANY
840 N. Michigan Ave., Chicago 11, Ill.

Please send complete information on:

- ☐ Type "R" Cutting Machine
- ☐ Type "JR" Cutting Machine
- ☐ CUT-O-MATIC Portable Cutting Machine

Name_____

Firm_____

Address_____

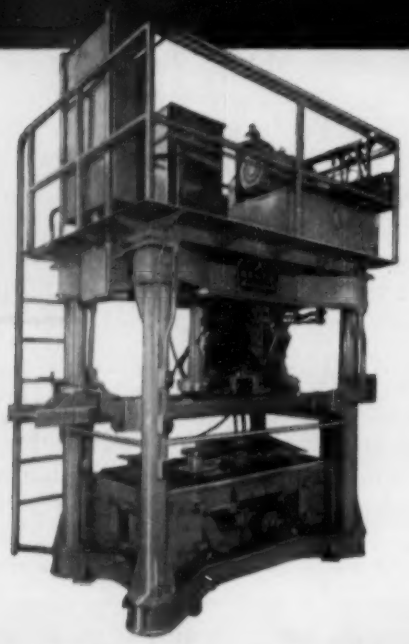
City_____ Zone____ State_____

HIGH PRODUCTION RESISTANCE WELDING

DELTA

WELDER CORP.

MACHINES AND EQUIPMENT



High production resistance welding equipment and automation devices . . . designed, engineered, and manufactured by Delta Welder . . . that's the "know-how" which assures lower production costs and improved product quality!

The record of outstanding performance compiled by Delta Welder equipment and automation devices is worth your examination.

Permit our sales engineers to show you Delta Welder equipment developments and machines that are saving time and money for nationally known manufacturers. Write or call. No obligation. Ph. Texas 4-8446.

DELTA WELDER CORPORATION

8525 Livernois • Detroit 4, Michigan

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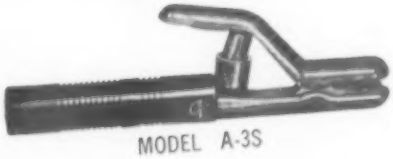
Duty-Cycle Rated for Top Production

JACKSON
Insulated Copper Alloy Holders

MODEL AW-C

MODEL A-1

MODEL A-3



MODEL A-3S

In today's competitive race for stepped-up production, we see new welding machines and new electrodes coming on the market, all designed to do the work easier and faster.

Therefore, in choosing the right electrode holder for a job, don't think of *rod size* alone. We must equally consider *amperage* and *cable size*, and today, more than ever, the required *number of electrodes per hour*. These four factors combined establish the *duty cycle*, that is the percentage of actual arc-time in any ten-minute period of work.

The following table shows the duty cycles possible with the various *Jackson Insulated Copper Alloy Holders*, based on using the electrodes and cable sizes as indicated.

Holder Class	Model Number	Electrode Size	Amperage	Cable Size	Duty Cycle
SMALL	AW-C	7/32"	250 300	1 1/0	50%
MEDIUM	A-1	1/4"	300 350	1/0 2/0	50%
LARGE	A-3	3/8"	375 450	2/0 3/0	65%
HEAVY-DUTY	A-3S	3/8"	500	4/0	80%

This table will help you in making the right selection from these Jackson copper alloy holders. Using a superior 98% copper alloy heat treated for greater strength, hardness and conductivity, these holders permit highest duty cycles with ample margin of safety.

Sold through Distributors and Dealers throughout the United States and Canada

JACKSON
PRODUCTS, INC.
WARREN · MICHIGAN

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